Standard Size, 9 x 12. APRIL 6, 1899. Price Six Cents.

LIBRARY OF CONGRESS
RECEIVED
APR 7 1899
PERIODICAL DEPT

AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.
ISSUED WEEKLY BY THE AMERICAN MACHINIST PRESS,
Vol. 22. 218 WILLIAM STREET, NEW YORK. No. 14.

Contents and Index to Advertisers, Page 8.

E. W. BLISS CO.

1 ADAMS ST., BROOKLYN, N. Y., U. S. A.

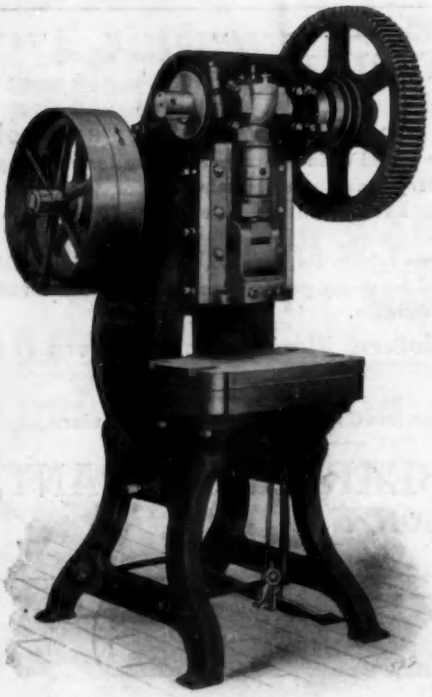
Western Office: 96 West Washington St., Chicago. **European Office: 12 Ave. de la Grande Armée, Paris.**
London Agency: The Projectile Co., Ltd., New Road, Wandsworth Road, S. W., England.
Berlin, Vienna and Cologne Agencies: Schuchardt & Schütte.

OWNING AND OPERATING

THE STILES AND PARKER PRESS CO.

CORRESPONDENCE SOLICITED. ESTIMATES CHEERFULLY FURNISHED.

For More Than Twenty Years.....



"Bliss" New Pattern Inclinable Power Press.

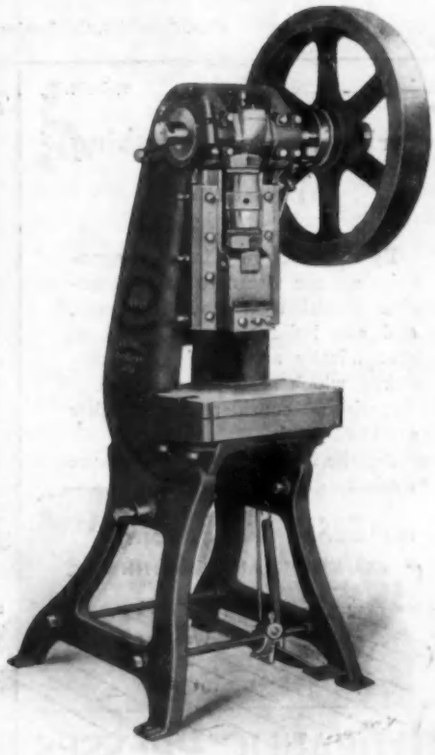
the "Bliss" Inclinable Power Press has been a favorite among manufacturers of sheet metal goods. Nearly all the largest and most successful concerns in the world are using them.

Their range of work covers nearly every kind of blank cutting, perforating, forming and combination die work, including a large proportion of the operations required in the manufacture of cans, pieced tinware, electrical goods, trimmings, etc.

Improvements in detail of construction have been made from time to time, and recently the Nos. 18 to 21 Presses have been re-designed and entirely new patterns made with increased weight and strength, so that they are unequaled for convenience, durability and wide range of usefulness.

All the details are given in a special pamphlet, which will be sent free on request.

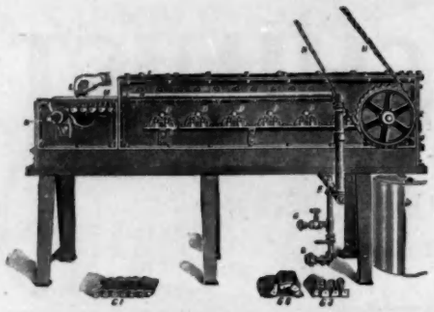
*****
*****



"Bliss" New Pattern Inclinable Power Press.

DESIGNERS AND BUILDERS OF

PRESSES, DIES AND SPECIAL M'CH'Y



"Willful Waste Makes Woeful Want."

It's willful waste to do tempering, annealing or case hardening with the old, back-number coal or coke furnaces—waste of time and fuel, and often of costly materials.

It may not make woeful want in your particular case, but it will make a difference that will be felt in the biggest and best of shops, as compared with the present-day Gas Furnace methods of doing such work—a difference in profits and in quality of output.

Here we show Heating Machine No. 4. This machine is designed for heating large quantities of small steel work of uniform size and weight, evenly and uniformly, to any required degree for hardening or for annealing, automatically. The output of this machine is over 1,000 gross of small, thin, steel articles in a single hour. Compare this with the capacity of any coal or coke apparatus you ever saw or heard of, and you'll be convinced that the clean, easy, economical, rapid, and accurate Gas Furnace way is the right way. Send for the other interesting particulars.

Write for Catalog of Fuel Gas Plants.

American Gas Furnace Co.,

23 John Street, New York.

Chas. Churchill & Co., London. Hermann Glaenzer & Co., Paris. Schuchardt & Schütte, Berlin and Vienna.

Grinding and Polishing Machinery.

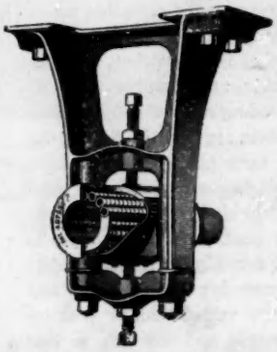
By manufacturing in large quantities we can afford to have expensive special tools and appliances, and can build these machines as economically and carefully as machines which are used for what is sometimes considered a higher grade of work.

All the more important parts are made to gages.

BUILDERS IRON FOUNDRY,
FOUNDERS AND MACHINISTS,
CODDING, WESTMINSTER AND DODGE STS.,
PROVIDENCE, R. I.

HYDRAULIC PRESSES
AND HYDRAULIC MACHINERY,
BUILT BY THE
BRANDYWINE MACHINE WORKS
WILMINGTON, DEL.

"The Age of Invention."



Rollers for reducing friction are not new. They would be in as universal use for shafting and machinery bearings as wheels are for vehicles, if they could have been made equally durable and efficient.

The wagon fulfills its purpose, but the rigid, solid roller, tested for many generations, has not been found reasonably durable.

The Modern Flexible Roller solves the problem.

Send for free Catalog and further particulars.

HYATT ROLLER BEARING COMPANY,
HARRISON, N. J.
133 Liberty Street, New York.

THE CUMBERLAND IRON AND STEEL SHAFTING CO
TURNED AND GROUND CUMBERLAND, MD.
HIGHLY POLISHED SHAFTING. U.S.A.

The Cumberland Iron & Steel Shafting Co.,
Turned, Ground and Highly Polished Iron and Steel Shafting, Cold Rolled, Cold Drawn and Compressed Round, Square, Flat and Hexagon Steel.
CUMBERLAND, MARYLAND, U. S. A.

Ales en acier tournes et aleses. Demander le prix-courant. Gedrechselte und polierte Stahlschaften. Preisliste auf verlangen frei. Cilindros de acero tornados y alisados. Se facilita lista de precios.

ENGINE LATHES, W. R. Colcord Machinery Co., 502 N. SECOND ST., ST. LOUIS, MO.

Our Annealed Die and Tool Steel

Saves Time, Labor, Money.

Crescent Steel Company,

Pittsburgh, Pa.
Chicago, Ill.
New York, N. Y.
Denver, Col.

Upright Drills,

20 to 40 inch swing, embodying all Modern Improvements, Accuracy, Strength and Convenience.

PRICES RIGHT.

Cincinnati Machine Tool Company,

AUGUST H. TUECHTER and SHERMAN C. SCHAUER.

Western Ave. and Dayton St., Cincinnati, Ohio, U.S.A.

You Are Wasting Money

If you are using imperfect balls after perfecting your cups and cones.

Trade Mark Registered.
All balls of a given size are always alike.

WE GUARANTEE that every ball we make is **a perfect sphere.** That every ball is within $\frac{1}{10,000}$ **of an inch** of exact size.

The Steel Ball Company,

Chicago, Ill., U. S. A.

COLD ROLLED STEEL

IN STOCK.

Strips and Sheets:
Cold Rolled for Stamping.
Cold Rolled for Drawing.
Cold Rolled for Saws.
Cold Rolled for Springs.

Bright Drawn:
Hexagon.
Flats and Squares for Key.
Flats and Squares for Parts.
Turned and Ground Shafting.

Dannemora Tool & Self-Hardening Steel.

EDGAR T. WARD & SONS,

23-25 Purchase Street, - BOSTON, MASS.

Leviathan Belting.

Tested under the hardest possible conditions and proved by years of service to be the best belt

For Heavy Driving of all Kinds.

Proof against Heat, Steam and Water.
Strength, Durability and Traction Power Unequaled

SOLE MANUFACTURERS:

Main Belting Co.,

1219-1235 Carpenter St., Philadelphia.
55 & 57 Market Street, Chicago.
120 Pearl St., Boston.

Send for Price Lists and Samples.

Yes; One of Card's.

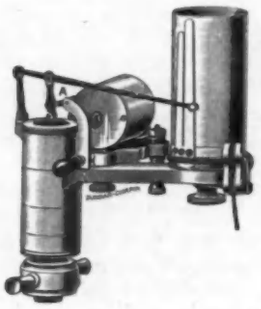
One of the kind you'll find in the shops of particular people, everywhere. Send for Catalog of Taps, Dies, Screw Plates, etc.

S. W. CARD MANUFACTURING CO., Mansfield, Mass., U. S. A.

Feel the Pulse Of Your Engine,

Keep informed as to what it will or will not do under varying conditions, then you'll get best results at least cost in time and fuel.

The only right way to do it, is by the use of an engine indicator—not any old indicator, but a Crosby Indicator, which diagrams accurately and clearly all changes of pressure.



The Crosby Indicator is designed to meet the requirements of modern steam engineering practice, and is especially adapted for use on high-speed steam engines.

We would like to send you full particulars of the Indicator and of the other high-grade products of our factory, such as Safety Valves, Gages of all sorts, Chime Whistles, Branden Pump Valves, Globe and Angle Valves, Blow-off Valves, Water Relief Valves, Lubricators, Gage Testers, Feed-Water Regulators, etc.

Crosby Steam Gage & Valve Co.,

Office and Works, Boston, Mass.

93 and 95 Oliver St., Boston, Mass.
78 John St., New York.
21 and 23 W. Lake St., Chicago.
75 Queen Victoria St., London.

Index to Advertisers.

	PAGE
Acme Machinery Co	16
Adams Co., The	42
Almond, T. R	55
American Emery Wheel Works	48
American Gas Furnace Co	2
American Tool & Machine Co	49
American Tool Works Co	11
Armstrong Bros. Tool Co	47
Backus Water Motor Co	47
Baird & Co., Henry Carey	55
Baird Machinery Co., U	45
Baker Brothers	48
Baldwin, Davidson & Wight	5
Ball Bearing Co	16
Barnes & Co., W. F. & John	4
Bartlett, Edwin E	46
Beaman & Smith	13
Becker Mfg. Co., John	46
Bement, Miles & Co	52
Berlin Iron Bridge Co	13
Besly & Co., Chas. H	56
Bethlehem Foundry & Machine Co	54
Bethlehem Iron Co	55
Bickford Drill & Tool Co	55
Bignall & Keeler Mfg. Co	54
Bilgram, Hugo	42
Bliss Co., E. W	1
Boston Gear Works	47
Bradford Mill Co., The	50
Brandywine Machine Works	2
Bristol Co	56
Brown & Sharpe Mfg. Co	56
Brown & Co., R. H	9
Buckeye Engine Co	55
Buffalo Forge Co	56
Builders' Iron Foundry	2
Bullard Machine Tool Co	47
Burt Mfg. Co	39
Carborundum Co., The	41
Card Mfg. Co., S. W	7
Case Mfg. Co	4
C & C Electric Co	53
Chadwick & Co., G. B	48
Chandler & Taylor Co	54
Chicago Pneumatic Tool Co	44
Cincinnati Mach. Tool Co	7
Cincinnati Milling Machine Co	50
Cincinnati Planer Co	42
Cincinnati Shaper Co	16
Cleveland Gear Works	39
Cleveland Machine Screw Co	4
Cleveland Twist Drill Co	56
Clough, R. M	55
Coffin & Leighton	47
Colcord Machinery Co., W. R	2
Cook Co., Asa S	9
Crescent Steel Co	7
Crosby Steam Gage & Valve Co	7
Cumberland Iron & Steel Shafting Co	2
Curtis & Co., Mfg. Co	14
Curtis & Curtis	4
Cushman Chuck Co	9
Dallett & Co., Thomas H	5
D'Amour & Littledale Mach. Co	10
Davis Machine Co., W. P	16
Dayton Globe Iron Works Co	54
Detrick & Harvey Machine Co....12 and	42
Diamond Machine Co	4
Dietz, Schumacher & Boye	48
Dixon Crucible Co., Joseph	3
Doan & Co., J. B	12
Draper Machine Tool Co	11
Dreses, Mueller & Co	46
Dwight Slate Machine Co	14
Eames Co., G. T	5
Eddy Electric Mfg. Co	39
Errington, F. A	9
Evans Friction Cone Co	10
Faneuil Watch Tool Co	56
Fellows Gear Shaper Co	39
Fifield Tool Co	56
Flather & Co	16
Foos Gas Engine Co	54
Fox Machine Co	16
Frasse Co., The	39
Frick Co	54
Garvin Machine Co., The	44
General Electric Co., The	14
Geometric Drill Co	9
Gisholt Machine Co	3
Gleason Tool Co	56
Goodyear, S. W	15
Gould & Eberhardt	16
Grant Gear Works	16
Gray Co., G. A	16
Hamilton Machine Tool Co	42
Hampden Corundum Wheel Co	9
Harrington, Son & Co., Edwin	51
Hart Mfg. Co	14
Hartford Steam Boiler Insp. & Ins. Co	39
Henderer's Sons, A. L	15
Hendey Machine Co	40
Hill, Clarke & Co. (Boston)	12
Hoggson & Pettis Mfg. Co	9
Horton & Son Co., E	9
Howard Iron Works	14
Hunt Co., C. W	54
Hurlbut-Rogers Machine Co	48
Hyatt Roller Bearing Co	2
Ingersoll-Sergeant Drill Co	47
International Correspondence Schools	42
Jenkins Brothers	41
Jones & Lamson Machine Co	16
Kempsmith Machine Tool Co	14
Keuffel & Esser Co	54
Landis Tool Co	3
Le Blond Machine Tool Co., R. K	56
Le Count, Wm. G	9
Lodge & Shipley Machine Tool Co	6
Long & Allstatter Co	14
Lucas & Gliem	16
Mansfield Machine Works	39
Main Belting Co	7
Maris Brothers	6
Marshall & Huschart Machinery Co	12
McCabe, J. J.....12 and	44
Mergenthaler & Co., Ott	53
Mietz & Weiss	54
Morrison, Wm. P	12
Morse Twist Drill & Machine Co	45
Morton Mfg. Co	14
Mossberg & Granville Mfg. Co	13
National Pneumatic Tool Co	10
Newark Machine Tool Works	16
New Era Iron Works	54
New Haven Mfg. Co	15
New Process Raw Hide Co	47
Newton Machine Tool Works, Inc	43
Nicholson File Co	41
Niles Tool Works Co	12
Norton Emery Wheel Co	55
Oesterlein Machine Co., The	16
Oster Mfg. Co	3
Palmer Brothers	54
"Patterns"	54
Pearson Machine Co	56
Philadelphia Bourse	42
Phosphor Bronze Smelting Co	6
Pierce Engine Co	54
Pond Machine Tool Co	5
Pond Machine Co., L. W	44
Potter & Johnston Co	6
Powell Planer Co	41
Pratt & Whitney Co	52
Pratt Chuck Co	9
Prentiss Tool & Supply Co	12
Putnam Machine Works	16
Q & C Co	13
Quint, A. D	5
Rand Drill Co	54
Reed Co., F. E	47
Reeves Pulley Co	42
Reinecker, J. E	49
Rogers Boat, Gage & Drill Works, John	46
Rue Mfg. Co	54
Safety Emery Wheel Co	14
Saunders' Sons, D	55
Sawyer Tool Co	10
Schlueter & Co., F. C	5
Sebastian Lathe Co	41
Sellers & Co., Inc., William	16
Seneca Falls Mfg. Co	10
Shultz Belting Co	16
Sibley & Ware	47
Silk, Anderson Co	47
Sittman & Pitt	14
Skinner Chuck Co	9
Slocomb & Co., J. T	49
Smith & Mills	39
Snyder, J. E	4
Speirs & Co., J. C	55
Sprague Electric Co	11
Springfield Gas Engine Co	54
Springfield Machine Tool Co	50
Standard Tool Co	46
Starrett Co., L. S	15
Steel Ball Co	7
Stevens Arms & Tool Co., J	14
Stiles Press Co., E. S	51
Stover Novelty Works	4
Stuart's Foundry & Machine Works, R. J.	56
Syracuse Twist Drill Co	6
Taunton Locomotive Mfg. Co	13
Tight Joint Co	6
Toomey, Frank	12
Trump Brothers' Machine Co	9
Towsley Mfg. Co., J. T	54
Turner, Vaughn & Taylor Co	49
United Correspondence Schools	39
United States Metallic Packing Co	48
Walker, O. S	56
Ward & Sons, Edgar T	7
Warner & Swasey	56
Watertown Engine Co	42
Watkins Co., F. M	54
Watson-Stillman Co., The	10
Weber Gas & Gasoline Engine Co	54
Webster Mfg. Co	54
Wells Bros. & Co	56
Whitcomb Mfg. Co	48
Whitney, Baxter D	47
Whitney Mfg. Co	51
Whiton Machine Co., D. E	52
Wiley & Russell Mfg. Co	9
Wiley & Sons, John	41
Winkley, F. D	9
Wood's Sons, T. B	42
Woodward & Rogers	4
Worcester Machine Screw Co	47
Wyke & Co., J	4
Wyman & Gordon	56
Young Mfg. Co., W. C	4

Contents.

	PAGE
Blueprints as Record Drawings	17
"Good Enough" Work	17
Rapid Blueprinting Processes. By Albert E. Guy	18
Iron Felt	18
Commercial Review	18
A New System of Bevel Gear Making.	20
Another Diagram for the Design of Shafts. By C. L. Griffin	22
Random Notes from Germany on Things Mechanical and Otherwise—II. By Henry Hess	24
Die Construction. By Geo. B. Painter	26
Filing Drawings by the Size of the Sheet—Book and Card Drawing Indexes	27
Machinery in Brazil	30
The Undercut Planing Tool Holder	30
Letters from Practical Men: Making a Pulley at Argentopolis. By The Judge....Amateurs' Foot Lathes. By F. H. Jackson....Steam Driven Road Carriages. By William H. Harrison....Shrink Fits. By Tecumseh Swift....A Problem in Rolling Sheet Metal. By Henry F. Noyes...."Overheads" on Lathes for Amateurs. By H. E. Keyle....Molding the Piston. By H. Bickle....A Die Maker's Vise or Clamp. By Ironquill....Promoting Inventions—An Engine That Varied the Power With Constant Steam Consumption. By W. H. Booth....A Supplementary Milling Spindle. By W. E. Willis	31-37
Questions and Answers	37
Personal	37
Obituary	37
The Corliss Steam Engine Works and the International Power Company	38
Technical Publications	38

AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION

VOLUME 22 NEW YORK, THURSDAY, APRIL 6, 1899 NUMBER 14

Published at 218 William St., New York
Every Thursday by the

American Machinist Press.

[INCORPORATED.]

JOHN A. HILL, President and Treasurer.
A. LEIGHTON DONNELL, Sec'y.

Editorial Department.
FRED J. MILLER, Chief.
FRANK RICHARDS, F. A. HALSEY, EDWARD P. BUFFET. } Associate Editors.

Advertising Department.
C. P. DAY, Eastern Representative.
JOHN MCGHIE, Western Representative.

Correspondence on mechanical subjects solicited. Name and address must always be given—not necessarily for publication.

Never address individuals, send all business communications to the American Machinist Press. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription Price.

$3 per year in advance, postage paid in North America.
$4 per year in foreign countries, postage prepaid.
No back Numbers beyond current year.
For Sale by Newsdealers, generally.

CHAS. CHURCHILL & CO.,
9 to 15 Leonard St., Finsbury, London,
Agents for Great Britain.

FENWICK FRERES & CO.,
21 Rue Martel, Paris,
Representative for France, Belgium, Switzerland and Italy.

Entered at New York P. O. as second-class mail matter

Blueprints as Record Drawings.

When the blueprint was introduced probably no one realized the extent to which it would eventually modify the entire system of drawing-office practice. At first it was looked upon as a useful attachment to existing methods, its chief purpose being to preserve expensive tracings by keeping them out of the dirt and grime of the shop, although not a little discussion was indulged in as to its real merits. The early prints were usually tantalizing things to use, and we well remember a wail of disapproval over the "taking of so much useful practice in making tracings from the hands of young learners in the drawing office." In all cases we think the prints were looked upon purely as shop drawings, to be destroyed as soon as their usefulness in the shop was over, the office record of progressive changes being kept by the drawings and tracings.

Draftsmen are, however, beginning to learn that the blueprint has a far wider application than this, and there is a distinct movement toward the reversal of the original practice—tracings being now scratched and altered as necessity arises without any attempt to keep a record of old work on them; so that instead of giving a history of changes as formerly, they now show current work only. Meanwhile the blueprint which formerly showed current work only, and was destroyed as soon as changes of any magnitude became necessary, has come to show a history of the changes by the simple expedient of marking it with serial number of the machines made from it, and then filing it away.

The article published elsewhere in this issue, in which the drawing-office practice of the Brown & Sharpe Manufacturing Company is given, illustrates this change of practice, and, as regards the point now under discussion, is closely in line with the plan followed by the Ames Iron Works, which was described at length in our issue of January 27, 1898.

The merits of the plan of filing away the blueprints as permanent records of what has been done are obvious. Not only is a complete record of all changes thus secured, but the active files are relieved of much lumber and reference is greatly facilitated. We fully expect this plan to grow in use as its merits become better known. The once despised blueprint bids fair to become a case where "the stone which the builders rejected has become the head of the corner."

"Good Enough" Work.

Most of us are familiar with the term "first-class workmanship," which has widely varying meanings in different sections of the country and in different shops, depending upon the standard of the locality or the practice of the shop. A job that would be called first-class or perfect in one shop might be called a botch in another shop across the street, and it is observable also that usually the shops which do the very best and finest work have the least to say about perfection of workmanship.

A shop noted for its fine work received an order for a lot of instruments which involved the use of some graduated circles or arcs. They asked their customer what allowance of error could be made in the finished instruments, and he replied that no allowance could be made; that they must be perfect. He was informed that so far as their shop was concerned they could not pretend to make perfect work, that all their work contained some degree of error and that these instruments would have to possess such errors, although they could be reduced to a very small limit, if he were willing to pay for such work. Finally, after a month or so of correspondence, it was agreed that the permissable error should be one minute of arc. A number of instruments were made, tested in the shop where made and found to possess errors of less than one-quarter of a minute of arc. They were shipped and pronounced by the customer to be "absolutely perfect," although regarded in the shop where made as being very far from perfect and far below their highest attainable degree of accuracy. It was simply a case of a different standard and different ideas as to what constitutes perfection.

Bearing on this matter John Brashear, of Allegheny City, tells of his experience with a man who came to him and wanted to know what he would charge for making a "perfect straight-edge of glass 36 inches long." Mr. Brashear informed the man that he could not make him a "perfect" straight-edge of that or any other length, but that he could make one with a very small limit of error, probably within a fraction of a light-wave length, and that it would cost about $40,000. The man thought that was rather high for a straight-edge for the purpose he was going to use it for, and it developed that what he wanted was a straight piece of glass over which to pass a strip of blueprint paper, the office of the straight-edge being simply to scrape off the surplus solution; and instead of a perfect straight-edge being required, that is, perfect in the sense of the term as employed by Mr. Brashear, one with an error of 1-64 inch would have been plenty accurate enough.

The fact should be generally recognized that absolute perfection is not attainable in mechanical structures. Those mechanicians who come nearest attaining it usually say, in speaking of their most refined work, "We can detect no error in it." This expression, of course, may mean much or little, depending upon who uses it and what is known of his means for applying refined tests and his ability to apply them.

It is true, therefore, that the term "good enough" is a perfectly legitimate one to be used in a machine shop. A "good enough" straight-edge was all the blueprint paper manufacturer needed, and the man who thought he wanted perfect instruments really wanted them only "good enough" to answer his purpose, beyond which further refinement was worse than useless. When a job of work is "good enough" for the purpose it is designed for it is time to stop work upon it.

Rapid Blueprinting Processes.

BY ALBERT E. GUY.

After much experimenting on the rapid blueprint process, I have found that the following method gives the best results: Sensitizing solution—Oxalate of iron and ammonia, 1; water (as pure as possible), 10. The iron salt dissolves in a few minutes. If a solution is prepared long in advance, it must be kept in a very dark place, in which case it can be preserved indefinitely. I would advise buying the best quality, and to make a fresh solution whenever required. The solution can be applied to the paper by means of a wide and soft brush, or the paper may be floated upon the solution in a shallow tray. The floating should last about one minute. I find brushing most convenient. The brush should be lightly loaded with liquid and be drawn evenly on the paper without passing twice at the same place. Any careful man can acquire the "hang" in five minutes.

The sensitizing and drying of the paper must of course be done in a dark place. The drying after brushing requires a few minutes only.

If this paper is exposed under a tracing to the sunlight an exposure of 30 seconds only is required. On a rainy day, the window being closed, I made a very fine print in 4½ minutes by holding the printing frame close to the window.

The sensitized paper has a yellow coloration, and where the light has acted the yellow color has become bleached, and the image stands as a positive in yellow lines on white ground. Still, as the lines are very faint, one must acquire a certain amount of experience to determine accurately at sight the necessary time of exposure. After making a dozen or two small prints in different kinds of weather, the operator can generally guess at the proper time; at least that has been my experience.

Develop the print as soon as it leaves the frame. Immerse in the following solution for two or three minutes, wash in water for ten minutes, hang up to dry. The image is in white lines in a blue ground.

Developing Solution—Ferricyanide of Pottassium, 1; water, 30.

These proportions need not be strictly adhered to. A weak solution is all that is necessary. Red prussiate does not dissolve readily in water. It is advisable to make in advance a solution 1 to 10 in a large bottle and keep it ready for use. Dilute it as required. This solution keeps very well. Most people object to developing in a separate solution, but this process is so simple that anyone who tries it *with a will* will be satisfied.

A "one-solution process" can be operated with the following sensitizer: Oxalate of iron and ammonia, 1; water, 10. Make one solution and mix, when ready to use, with an equal part of this other: Ferricyanide of potassium, 1; water, 10. Sensitize paper as before with a brush or by floating, and develop by simply washing in water like ordinary blueprint. The exposure required is the same as in the previous case, with the advantage that the progress of the printing can be watched. As soon as the light acts the paper turns blue. When this color is sufficiently intense, remove the print from the frame and wash. The print after washing retains the same color as before.

It is impossible to make this solution keep, and th paper prepared in advance keeps only one or two days in good printing condition. The lines are not very white.

New York.

Iron Felt.

A new insulating material, to which the above name is given, and which is made at the Aldershof Works, near Berlin, is coming into extensive use in Europe. As described in "The Society of Arts Journal," the felt consists essentially of long and strong woolen fibers, impregnated with a by-product of petroleum, and then coated (with a certain amount of penetration) by gelatine rendered insoluble, and also (alternatively or in addition) with india-rubber, afterwards vulcanized. After being subjected to considerable pressure, the iron felt assumes the form of plates, measuring 20 square centimeters (2 square feet 22 square inches) and upwards, with a thickness varying from 1 to 5 centimeters (13-32 inch to 2 inches). These plates are very elastic, being practically imperishable, while they will stand a pressure of 1,458 kilograms per square centimeter (20,736 pounds per square inch); and their surface is so hard as not to be cut by the sharp edges of bolt heads or of iron girders. Placed as a cushion between rails and their chairs, or sleepers, underneath plummer-blocks or between engines and their foundations, this substance is also stated to prevent vibration.

The United States Government has just had a rather costly experience with smokeless powder. A new 10-inch gun was being tested at the Sandy Hook Proving Grounds, smokeless powder being used, when the gun burst longitudinally, that is, the breech was blown out, killing one man and seriously injuring several others. The theoretical pressure for the charge used was 35,000 pounds, but the gage went to its limit of 79,000 pounds, so that the actual pressure exceeded those figures. It is supposed that the nitro-glycerine in the powder had not been thoroughly mixed with the other ingredients, and that detonation occurred instead of the regular powder explosion. It is claimed that some of the smokeless powders are entirely stable and can be depended upon so far as dangerous deterioration goes, and a gun would seem not to be the best means for testing this quality of a powder.

Commercial Review.

NEW YORK SATURDAY EVENING,
April 1, 1899.

The boom in trade is noisier than ever. The curve which represents business improvement seems to be still following a steep up-grade, with a prospect of rising to greater hights above the horizontal axis. There is a slight droop in the curve of crude iron sales, but not enough to denote a reversal of general upward conditions. It is now in order to speculate when the maximum will be attained. That the present wave of activity has sufficient momentum to carry it through the present year, however, there is little question. One of the best features of this wave of activity is substantial industrial character. That fact has been manifest in the pig iron market. Iron has been and is now in demand for actual consumption. It is in requisition because factories all over the country are putting in new machinery, which they need to fill their increased orders; because new shops and mills are being started up to catch the tide which taken at the flood leads on to fortune; and because railroads are making long-needed repairs which economy no longer forces them to defer. This state of affairs is in contrast to that meteoric boom of 1895 which flashed in the sky of depression and quickly burned out. In the New York office of an iron brokerage firm which handles more pig iron probably than any other in the country, a representative of the "American Machinist" was informed not long since that, whereas, in the 1895 boom from 100,000 to 150,000 tons of iron were bought from that office for speculative purposes, only about 2,000 tons have been taken by speculators this season.

ENGINES AND BOILERS.

It looks as if March has proved the most active month in the engine and boiler markets that has been known for many years. A sign of the freedom of capital resulting from healthy times is the urgent demand for engines of the larger sort, from 500 to 1,000 horse-power. They are in requisition for both electric and manufacturing purposes. Some of the companies are prevented from taking on work which they might otherwise have received, because they are already so crowded with orders. One of the companies most reputed for engines of the Corliss type is sold out for the remainder of the year, except as regards a few small engines. In a city not far from here there are two manufacturers of Corliss engines high in grade and in price, who are reported as having not enough to do to keep them busy; so it appears that no one need suffer for the want of a Corliss engine, if he is willing to pay for it. But the cases of activity rather than those of dullness are now the true indices of market conditions. Stiffening of prices has continued during March. The matter of figures is irregular

and confused. Some do not think that the asserted higher askings for engines mean as much in actual sales as it would appear. A case is cited in which twenty-seven proposals were put in upon a contract to furnish a 300 horse-power Corliss engine four weeks ago, and after a fortnight had elapsed only two had been withdrawn. The increases made by different companies have indeed been very unequal. Advances are reported all the way from 0 to 25 per cent. As in the days of Dutch weathercocks on the roofs of Manhattan, every man could find a wind to suit himself, according to where he looked for it, so now everyone who wants to buy an engine can pay a greater or less increase in price, as he chooses.

On boilers the advances made from January 1 to date range from 0 to more than 30 per cent. With plates about double what they formerly were and tubes marked up one-half or two-thirds, makers of boilers, particularly those of the fire tube type, are well justified in their higher charges. Owing to the congestion of the material market, deliveries on boilers now rule about three months where material is not in stock.

The inability to quote prices on engines and boilers for any length of time is, as might be expected, working havoc with export trade.

The local office manager of one of the steam pump companies that have entered into the consolidation expresses himself as at sea with regard to the probable outcome. Although formal incorporation has been effected the new company is not yet completely organized. Its members are still cutting each other's throats in competition. He thinks that the separate office arrangements of the component companies will be maintained much as formerly, although in course of time more or less consolidation of selling agencies will probably be effected. None of the factories will be closed, our informant maintains. He believes the objects of the consolidation to have been honorable and legitimate, for reasons of business economy and not as a financial speculation. In this the manager of another office concurs. The former seller alludes to the European orders of his own company as having of late been particularly good.

The following from among contracts received by the Bass Foundry & Machine Works will show some of the industrial lines where improvements are taking place: Tyler Tube & Pipe Works, Washington, Pa., a 24x48-inch engine; Falcon Iron & Nail Company, Niles, O., 32x60-inch; E. L. McClain Manufacturing Company, horse goods, Greenfield, O., 22x48-inch; Lawrence Cement Company, Binnewater, N. Y., 56x48-inch, to compound with their present engine; Waterbury Manufacturing Company, Waterbury, Conn., 22 and 48x60-inch cross-compound; Armour & Co., Chicago, 32x60x48-inch compound; Armour Packing Company, Kansas City, 32 and 62x54, compound; American Oak Leather Company, Cincinnati, O., fourteen 72-inch by 18-foot high-pressure boilers. All these engines are for delivery in the next ninety days. Other contracts have been taken for later delivery.

The Frank M. Pierce Engineering Company has taken a contract to install a 250 horse-power Erie Ball engine for the Amsterdam Street Railway Company, Amsterdam, N. Y. It will be direct connected to two 80-kilowatt General Electric generators. The Frank M. Pierce Engineering Company has also shipped a 100 horse-power engine for electric work at a mining plant in North Japan, and is having two 125 horse-power engines built to go to the same country.

The latest projected consolidation hinted in the engine market is one among long-stroke engine manufacturers. This makes the third under discussion, the others being that of the American Wheelock, reorganized Corliss, etc., and that of the high-speed engine builders, which certain parties are agitating. A consolidation of some sort is also talked of by the boiler manufacturers, but the practicability of the project is generally viewed with incredulity.

The Edward P. Allis Company has contracted to furnish two 750 horse-power, direct-connected, vertical, cross-compound condensing engines to the North River Light, Heat & Power Company, Hoboken, N. J., and two direct-connected horizontal cross-compound condensing engines of 300 and 450 horse-power, respectively, for a new electric railway at Lebanon, Pa.

The Stirling Company, water-tube boiler manufacturers, have contracted to furnish 3,200 horse-power of boilers to the American Steel & Wire Company.

The Abendroth & Root Manufacturing Company will ship two 200 horse-power boilers to Cuba.

MISCELLANEOUS.

The Toledo Machine & Tool Company reports a heavy demand for all classes of presses and tools for sheet and bar metal work. The company has recently shipped three outfits for complete lines of gas and oil stoves, and is now crowded with orders.

Mr. Frank M. Pierce, president of the Frank M. Pierce Engineering Company, returned a few days ago from a business trip in Cuba and Porto Rico. When interviewed by a representative of the "American Machinist" he said: "There is practically nothing yet in engineering and machinery business in Porto Rico. New life must first be introduced. In Cuba, aside from one or two railroad franchises, virtually nothing is doing, because the war is so recent that the energies of the people have to be devoted directly to keeping off starvation. Therefore, if anyone goes to either island with the intention of making present sales of machinery he would better have stayed at home. This time, however, is fairly good for the establishment of trade connections. I dare say there will be considerable business by the next sugar season. Both islands are practically without either carriage roads or railways. The topography and the character of the trade to be obtained favor the establishment of electric railways, especially in Cuba, for use in connection with the sugar industry in and about plantations and for conveying the sugar to trunk lines for shipment to ports. There will not be a good market for tools for repair purposes or otherwise until American capital has built up new enterprises."

The addition which, as mentioned in our last report, the Hamilton Machine Tool Company is building to its plant is expected to cost with the equipment $25,000. It will be of brick and will include a large erecting room, polishing department, drafting room and pattern shop. Much new machinery will be installed.

PITTSBURGH REPORT.

Manufacturers of all kinds in the Pittsburgh district have about all they can attend to for the next eight or nine months, and are to-day making prices to suit themselves. It is apparent that no lower figures will be asked for any kind of material for the balance of the year than now. During the past week or two rates for all grades of iron advanced as regularly as the sun rose, and many began to wonder when they would cease. No. 2 foundry iron, which was selling for $11.50 on the first day of March, is now being quoted at $16.50. This is thought to be the greatest advance known in the history of foundry irons in such a short period. The product is getting scarcer each day, and it is probable that prices "have not seen their finish." In the pig-iron trade there has been some very heavy buying within the past week, the National Steel Company getting 90,000 tons, Carnegie Steel Company, Limited, taking 20,000 tons, and various other concerns taking almost as much at figures ruling at $14.50 in the Valley, or $15.15 at Pittsburgh, delivered. It is said there is a lot more of the material to be had at the same price, and many more sales can be looked for at any time.

Plates are in very strong demand. Inquiries for lots of 1,000 tons and more have gone begging in this city for the past two or three weeks. Mills are unable to furnish the material at any price, being filled up to the utmost capacity. Boiler manufacturers are in bad shape on this account, and are somewhat uneasy, and structural makers cannot see their way clear to take on many contracts calling for anything like early delivery. Where and when these conditions are to end is a problem many are endeavoring to solve.

Many new plants are being contemplated in and around this locality. A new company has been formed to make steel castings, and let contracts for a portion of its machinery on Thursday last. The

Westinghouse Electric & Manufacturing Company was given the contract for a 40-kilowatt generator. The contract for the other electrical machinery will be awarded later on. The Shiffler Bridge Company will put up the buildings; the Morgan Engineering Company, Alliance, Ohio, will furnish one 20-ton and one 10-ton electric traveling crane. The Pittsburgh Steel Foundry Company has just been organized, and will be in the market for the equipment of the works in a very short time. It is understood that the works will be located at Glassport. Another new concern is the James H. Baker Manufacturing Company, which will erect a plant at Tarentum, Pa., for the manufacture of wagon hardware of all kinds. No contracts have yet been let for this work.

The Pittsburgh Horse Shoe Company, recently organized in this city, has its plans for the power plant about completed. In all there will be about 600 horse-power wanted. In this plant there will be two 5-ton jib cranes installed; four heating and one tube-welding furnace will be erected. Another concern is looking for a site on which to build larger works. The chain plant of James McKay & Co., in this city, is entirely too small to handle the business now being done, and efforts are being made to secure a site where good shipping facilities are to be had.

The outlook for the next year or so seems exceedingly good, and a great deal of money will be made within the year.

CHICAGO MACHINERY MARKET.

The consensus of opinion among the sellers of generators and dynamos is that trade is better than a month ago. The complaint with which engine and boiler makers have been afflicted for some time, namely, a superabundance of business and an inability to make desired deliveries, has appeared in mild form among some of the electrical men. Whereas a shipment on two weeks time has been the rule, the shops of motor builders are now so well filled with orders that a month's delivery is the best that can be obtained in many instances. But the engine builder stands between the electrical machinery manufacturer and the wrath of the buyer, for the latter usually goes first to the engine maker, and when he there learns that he must wait several months for his engine he is reconciled to the lesser delay of the motor man. Prices are hardening somewhat, but there has been no general advance in values within the past month, like that which has come to the iron and steel and the iron machinery markets.

The burst of eager spring activity in miscellaneous manufacture, for which many are looking, has doubtless been delayed by the lingering winter, but the mails of electrical power machinery makers show an increasing number of inquiries, and there is expectation of a livelier trade in the coming weeks than at any time yet this year. March business was generally satisfactory in volume and there has been steady increase since the beginning of the year, but the ascent has been gentle, especially as relates to industrial plants. Street railway operations are active, but the introduction of generators and motors into manufactories, while satisfactory when considered by itself, rather suffers by comparison with electric railway trade.

Among the orders which the Crocker-Wheeler Electric Company have recently taken is one for twenty-two motors, aggregating about 500 horse-power, to be used in the packing houses of Armour & Co., in this city.

The Siemens & Halske Electric Company, of this city, has recently commenced the manufacture of a line of slow-speed motors, designed especially for industrial plants. The company now employs 260 men and expects to add 100 more within a week or two. It has just increased its drafting force 50 per cent.

Quotations.

NEW YORK, Monday, April 3.

Iron—American pig, tidewater delivery:—

Pennsylvania irons:	
No. 1 X foundry	$16 75 @ 17 00
No. 2 X foundry	15 75 @ 16 00
No. 2 plain	15 25 @ 15 50
Gray forge	14 75 @ 15 00
Alabama irons:	
No. 1 foundry	16 25 @ 16 50
No. 2 foundry	15 75 @ 16 00
No. 3 foundry	15 25 @ 15 50
No. 1 soft	16 25 @ 16 50
No. 2 soft	15 75 @ 16 00
Foundry forge	14 75 @ 15 00

Bar Iron—Base—Mill price, in carloads, on dock: Common, 1.48 @ 1.50c., nominally; refined, 1.58 @ 1.60c. Store prices: Common, 1.65 @ 1.75c.; refined, 1.75c., upward. A new list of extras has gone into effect at mills, and with some exceptions, among New York sellers. Base in rounds and squares is now 1 to 1⅞ inch, inclusive, instead of ¾ to 2 inches, inclusive.

Tool Steel — Base Sizes — Standard quality, 6 @ 7c.; extra grades, 12 @ 14c.; special grades, 16c. and upward.

Machinery Steel — Ordinary brands, from store, in small lots, 2.00c.

Cold Rolled Steel Shafting—Base sizes, from store, in small lots, 2.75c.

Copper—Carload lots, Lake Superior ingot, scarce, 18 @ 18½c., nominally; electrolytic, 17¼ @ 17½c.; casting copper, 17 @ 17¼c.

Pig Lead—Carload lots, 4.30 @ 4.32½c., f. o. b. New York.

Pig Tin—For 5 and 10 ton lots, 24⅛ @ 24¼c., f. o. b. New York.

Spelter—In carload lots, 6.40 @ 6.55c., New York delivery.

Antimony—In cask lots and over, 9⅞ @ 11c., according to brand and quantity.

Lard Oil—Prime City, present make, 45 @ 47c., in wholesale lots.

A New System of Bevel Gear Making.

The great activity in bevel gear making machines which prevails in this country at the present time has been commented upon in these columns already. The latest development in machines for this purpose is shown in the accompanying illustrations, which are from machines made by the Brown & Sharpe Manufacturing Company from designs by Mr. O. J. Beale, the well-known gearing expert of that company.

This is more than a new machine, being a new process as well, based on a fundamentally new conception of the method of attacking the problem, and one which we believe is not so much as hinted at in treatises on gearing. The process is a generating process, but of a radically different nature from others of that class.

It is well known that if a gear of hard material, as iron, be rolled with a gear blank of soft material, as wax—the correct rolling of the pitch surfaces being insured by outside means—the iron teeth will impress tooth forms in the wax which

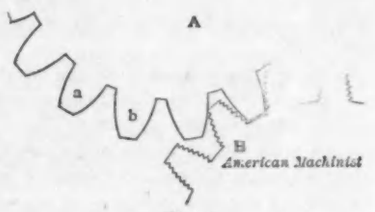


Fig. 1

THE PRINCIPLE OF THE SYSTEM.

are conjugate to their own and which will mesh correctly with them and with others made in the same manner from the same original. This system is based on this principle, the gear to be cut being previously roughed out with a milling cutter so as to engage with the finishing cutter or generator, which is a correctly formed gear with the sides of its teeth made with file surfaces so as to remove the surplus metal from the roughed-out blank and thus reduce it to the correct form.

Fig. 1 is a sketch showing the principle of action of this method. *A* is a roughed-out blank, the teeth *a b* having some stock still to come off. The finishing cutter or generator *B* has teeth of correct outline, but formed into file surfaces, and the effect of forcing the two to revolve together is that the file teeth remove the surplus stock, as indicated by the dotted lines—the teeth *c d* having been reduced from the forms of *a b*.

The practicability of the system depends upon the fact that the teeth of a crown gear, like those of a rack, may have straight sides, which, of course, are easily made, and form the starting point from which the curved teeth of the other gears are generated—a single generator answer-

ing for all bevels having the same pitch and the same pitch cone apex. It will be understood, of course, that in the actual machine the teeth are not reduced to their final shape at a single pass over the generator teeth, as indicated in Fig. 1, but that generator and blank are revolved together while being gradually approached to the correct position.

Fig. 2 is from a photograph of a generator and shows clearly the construction of the file surfaces of the teeth. The

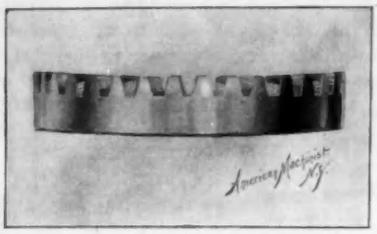


FIG. 2. FILE TOOTH GENERATOR.

figure also shows the arrangement of the file teeth parallel, in one tooth, to the root, and in the next to the top of the tooth, whereby the filing action of each tooth crosses the direction of the previous tooth action. Like any other file, these teeth are not able to remove any large body of metal without being worn out. In the case of small gears, in which the ratio of the inner to the outer radius is large, a milling cutter which removes all the metal possible from the outer ends of the teeth will still leave considerable stock to be removed from the inner ends, and for such gears an additional or roughing generator is used before the file generator. This roughing generator is shown in Fig. 3, and differs from the filing generator in having teeth with plain surfaces, but mutilated in their lengths. The edges resulting from the removal of the tops of the teeth are sharp and act as cutting tools to remove the bulk of the remaining metal, thus leaving but a small amount for the filing cutters. The teeth of the mutilated tooth cutters may of course be sharpened for a limited number of times. Following the file cutters a burnishing generator—not shown—is used. This is simply a generator hardened, but having plain and complete teeth, which is run in mesh and under pressure with the gear being made, the action being to burnish the finished teeth and leave a condensed burnished surface, which is peculiar to this system of construction.

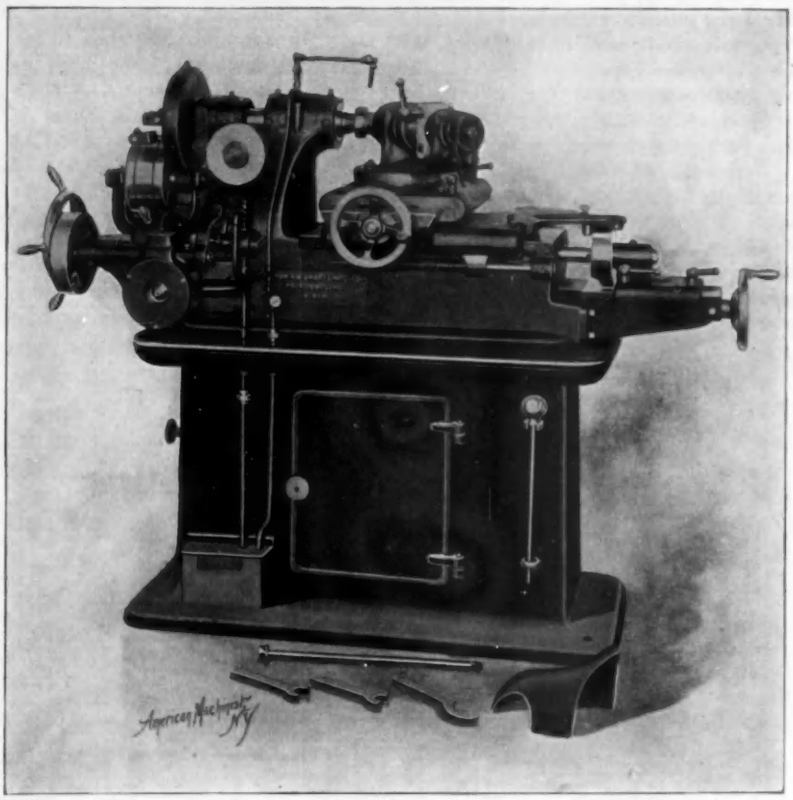


FIG. 4. GEAR GENERATING MACHINE.

This system of generators may be used in an ordinary universal milling machine, but for the manufacture of gears on a large scale, as is now demanded by the chainless bevel gear bicycle trade, special machines are desirable, and such a machine is shown in Fig. 4, which is from a photograph of one of several at work in the Brown & Sharpe works. A view from the opposite side and upon a large scale, showing the generator in action, is seen in Fig. 5. The generator in Fig. 4 is of the filing type, while that in Fig. 5 is of the mutilated type.

FIG. 3. MUTILATED TOOTH GENERATOR.

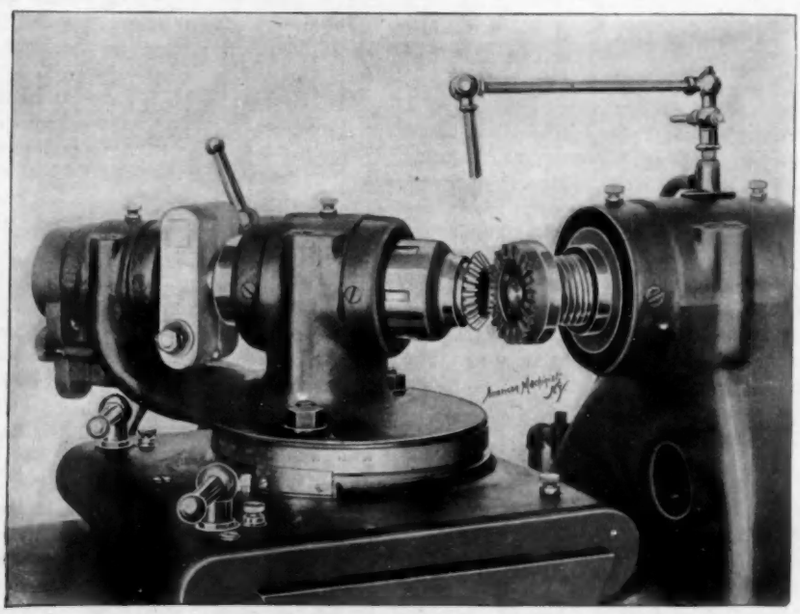


FIG. 5. GENERATING CUTTER IN ACTION.

Fig. 6 is a plan view of the machine,

and from it the handling and operation of the machine will be apparent. A shaft *a* runs right through the machine and has a cam *b* upon its right-hand end, by which cam and its roller *c* attached to the slide *d* the pushing of the gear and generator into mesh is effected. When the roller is at the bottom of groove *e* the gear blank is withdrawn from mesh with the generator, but on turning shaft *a* and cam *b* by the hand-wheel *f* until the roller has mounted the cam, the gear is brought to the position where cutting begins. Further rotation of cam *b* is effected by a belt on pulley *g*, the cam having a gradual rise as it turns. The generator and blank are meanwhile being turned by open and crossed belts on pulleys *h i j*. Shippers operated by a train of mechanism connected to pulley *g* serve to reverse the motion of generator and gear from time to time as the two are crowded into mesh, until the completion of a turn of cam *b* when the pitch surfaces are in contact and the cutting is complete. The power is now thrown off and the hand-wheel *f* is turned until roller *c* drops into the groove *e* of cam *b*, when generator and blank are again out of mesh and the latter is replaced by a new one. Hand-wheels *k l* are for initial adjustment when setting up the machine for a given lot of gears.

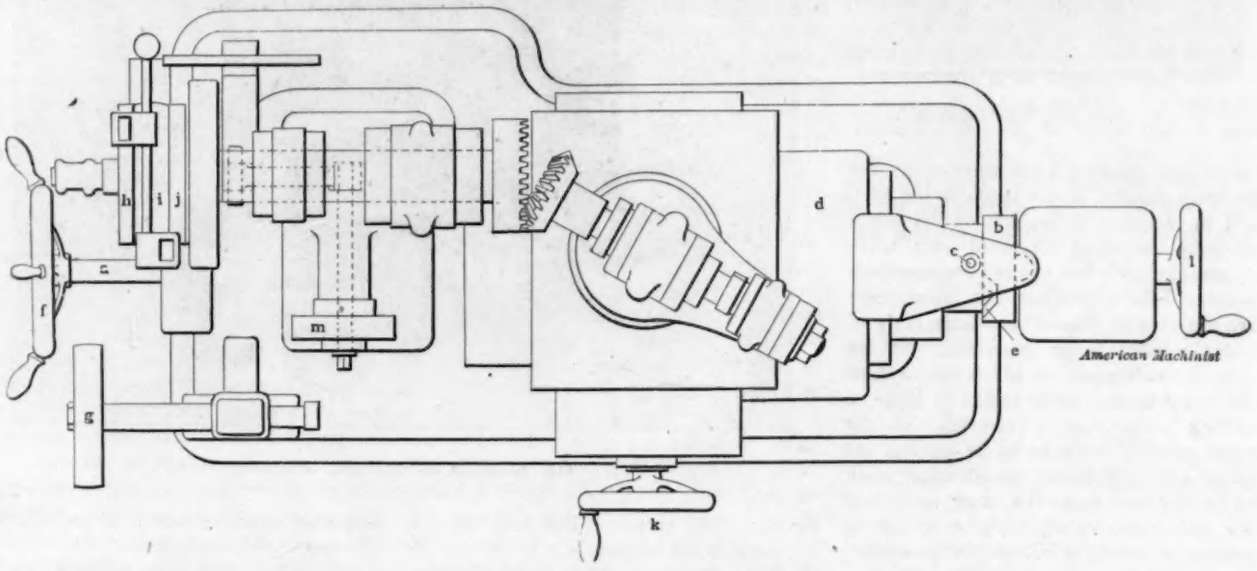


FIG. 6. PLAN OF GEAR GENERATING MACHINE.

With large gears and a blunt angle between generator and gear blank shafts, the filing action of the generator teeth is much less than when gears of the opposite character are in the machine, and to increase the filing action in such circumstances a short reciprocating motion is given to the generator shaft through a concealed mechanism operated by pulley *m*, Fig. 6, which will also be seen in Fig. 4. This mechanism may be employed or not, as needed, and in point of fact is used only on gears having the bluntest angles.

Another Diagram for the Design of Shafts.

BY C. L. GRIFFIN.

In February, 1896, the "American Machinist" published a shaft diagram under my signature, and since then it has had other contributions of the same nature. I think I have seen them all. The one I have been looking for has not yet appeared, however, and in my attempts to produce it, I have probably produced enough schemes and lines of diagrams to fill up two or three regular issues. What I wanted was a single diagram which would read by a straight-line relation, diameters at any fiber stress for any simple bending, simple twisting, or combination of bending and twisting moments. I did not consider that the complication of two diagrams would do. I wanted it all in one.

The accompanying diagram almost fills the bill, so nearly so that I am satisfied with it. The only feature it lacks is direct reading for *any* fiber stress, and I partially eliminate that by the proportional table, which does, indirectly, give a reading for any fiber stress. For my own use, I have found that 8,000 pounds fiber stress for ordinary machine shafts is a safe, reliable and economical figure; hence, for myself, the diagram is practically complete, even without the proportional table.

The lines in groups *A, B, C,* etc., represent ratios of bending to twisting. The lines in groups *A', B', C',* etc., represent the equation for equivalent twisting:

$$T_e = B + \sqrt{B^2 + T^2},$$

reduced to the form $T_e = T \times$ a constant, said constant being found by substituting for B its value in terms of T for any particular value of the ratio of B to T. For example when $B = 2T$,

$$T_e = 2T + \sqrt{4T^2 + T^2} = T(2 + \sqrt{5}).$$

Thus on the diagram, groups *A, B, C,* etc., identify the ratio of B to T, while groups *A', B', C',* etc., take this identification and read corresponding equivalent twisting moments.

Convenience, simplicity and quick reading are the points aimed at in the diagram. The lines are intended to be close enough together to admit of ready interpolation, and yet not so close as to be confusing.

The diagram's chief function is to read equivalent twisting moment for any combination of simultaneous bending and t isting. Incidentally, diameters from 1 to 10 inches are read directly, not only for this equivalent moment, but also for simple bending or simple twisting moments, at fiber stress of 8,000 pounds per square inch. Diameters at other fiber stresses are obtained indirectly by multiplying the diameter at 8,000 by suitable factors, as shown in the proportional table.

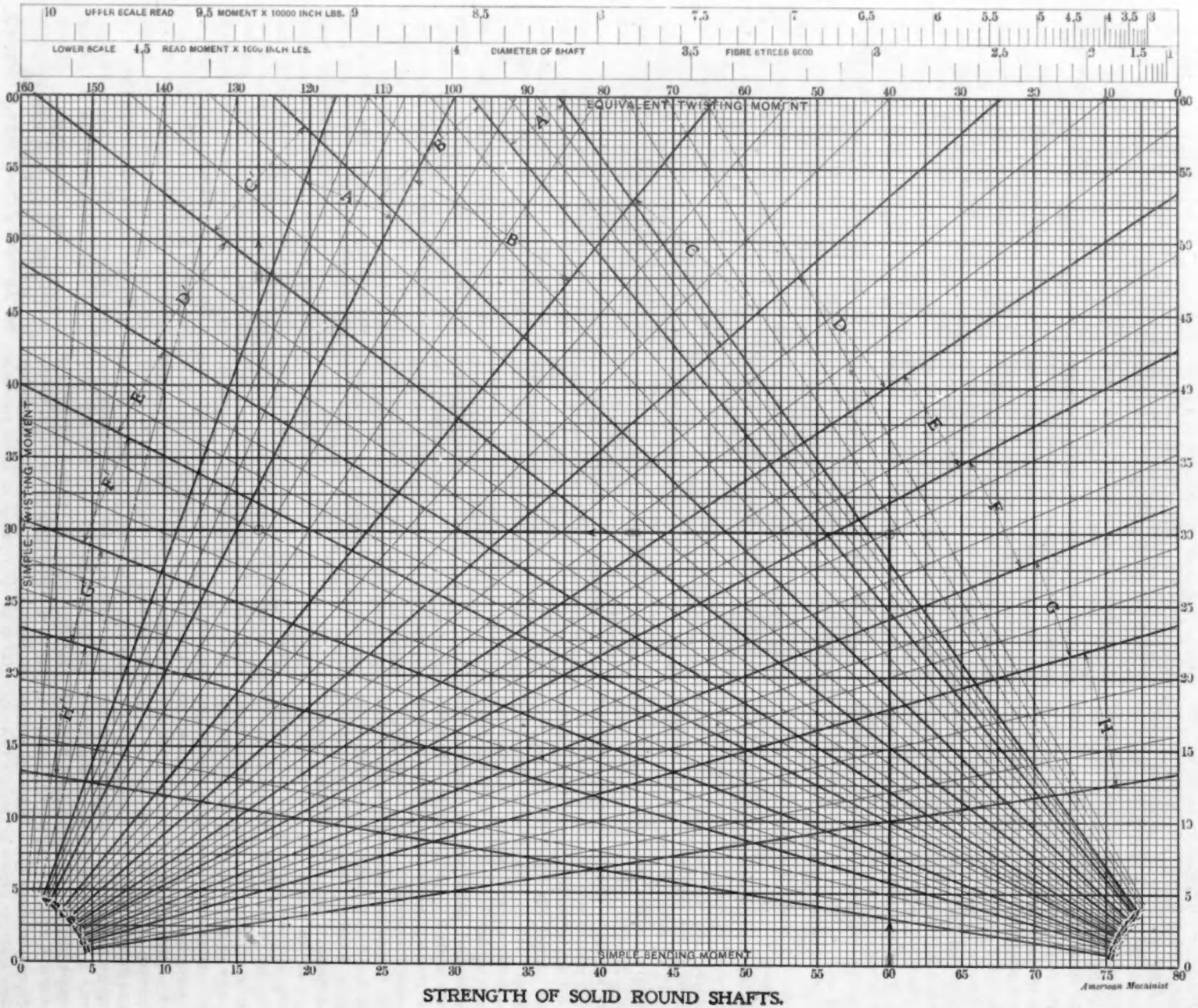
The numbers representing moments being abstract, any multiple of these can be used, thus giving indefinite range.

The diagram is as accurate as manual skill can make it; yet as the engineer's purpose is not subserved by a micrometer reading, no attempt is made to subdivide beyond what his use of the diagram would call for in the regular range of his practice.

One of the latest innovations in the matter of apprenticeship in machine shops has been introduced by Messrs. Warner & Swasey, of Cleveland Ohio, who make the term of apprenticeship for a high school graduate one year less than for a boy who has not such an education to begin with; the idea being that the boy who has gone through the Cleveland high schools has already acquired a considerable stock of knowledge which he ought to possess in order to become a first-class workman in any event, and that by such graduation he has in reality gained so much time and should be entitled to credit for it.

AMERICAN MACHINIST

April 6, 1899.



STRENGTH OF SOLID ROUND SHAFTS.

PROPORTIONAL TABLE.		
Dia.	FIBRE STRESS.	
	Exact.	Approx.
1.2	4630	4600
1.17	4995	5000
1.10	6010	6000
1.05	6908	7000
1.00	8000	—
.95	9330	9000
.92	10274	10000
.90	10974	11000
.87	12150	12000
.85	13027	13000
.80	15625	16000
.75	18962	19000
.70	23324	23000

USE OF DIAGRAM.

Locate in A, B, C intersection of bending and twisting moments.

Follow horizontally to similar location in A′, B′, C′.

Follow vertically up and read equivalent twisting moment and diameter of shaft.

For Bending without twisting: Multiply given moment by 2; find the result in top line of diagram and read diameter on scales above.

For Twisting without bending: Read top line directly and diameter on scales above.

Example No. 1. Bending, 60,000 in. lbs.; twisting, 30,000 in. lbs.; equivalent T. 127,100 in. lbs.; diameter, 4.33 inches.

Example No. 2. Bending, 600,000 in. lbs.; twisting, 300,000 in. lbs.; equivalent T. 1,271,000 in. lbs.; diameter, 9.32 inches.

Random Notes from Germany on Things Mechanical and Otherwise—II.

BY HENRY HESS.

The German Government carefully sees to it that accidents are minimized, by insisting on safeguards everywhere—even the change-gears on lathes must be housed in. In larger establishments a doctor has a regular office, where he is in attendance during certain hours each day, to attend not only to injuries, but also the general health of the men and their families. His pay comes from the insurance fund to which the men, the firm and the government contribute. Some day, when I shall have had actual personal experience with it, I hope to find time to give the results of this compulsory industrial insurance as it exists in German machine shops.

THE LOEWE WORKS AND BUSINESS.

When we were about ready to come home they were just finishing the removal of machinery from the old Ludw. Loewe factory to their new plant. This is unquestionably, as regards buildings and appliances and attention to the comfort and well-being of the men, one of the finest, if not the finest, plants in existence for the manufacture of light and moderate weight machine tools. This firm was the first to recognize the superior designs of Americans in this line, and started in, something over twenty years ago, to introduce similar products made by German mechanics. The first plant was on a quite modest scale in the heart of the city. The two brothers Loewe lived in the house facing the street, while the shop was in the rear. Gradually, as the demand grew, shop was added to shop, adjoining property purchased, and the residence converted into office rooms, until at last it became impossible to expand farther on the old ground. It then was decided to go to Martinkenfelde, a manufacturing suburb of Berlin. Long before that time, however, conditions had come to a pass where it became exceedingly difficult to carry on work economically. Imagine not only an underground blacksmith shop, but also an underground foundry, and part of the latter overflowing to a second story, and daily pouring going on at both levels. One floor of the office building had been relinquished to us for our work, so we naturally saw much of the old shops in the rear; but though our noses told us that there must be a foundry somewhere about, it was quite a while before they led us to gather the scent underground. Not the least of the remarkable facts connected with this concern is that during all these years they had not a single traveler or branch house. Not content with a business that was quite enough to occupy an ordinary man fully, the head of the firm went into the manufacture of small arms, of electrical machinery and the installation of electric light and power plants; all of which concerns are among the largest and most stable in the country, as is evidenced by their stock being quoted at about 456. And still he is taking in work, and yet more work; a type-setting machine has just been carried through the experimental stage, and now there is a further expansion of the machine-tool line into the heavier and heaviest types of machines built on Niles lines. The inception of this latest enterprise is due to Col. Alexander Gordon, the far-seeing head of the American firm, who will be for some time to come its guiding engineer. It is expected that by about the beginning of next October the new plant will be ready for active operations.

PUBLIC CONVEYANCES.

They have one thing in Berlin that anyone who has to go about there much soon begins to appreciate, and that is an almost ideal hack service. Within the business and residence districts of all but the poorest, hackstands can be found always at nearby corners; and if one does not choose to go to one of these, he need wait but a few moments for a hack to come within hail, with a prominently displayed "empty" sign. The hacks are of two general types—the first is paid for by time; the second are called taxameters, and have a rate governed by both distance traversed and time. To a mechanic the "taxameter" proper, which means "fare-indicator," proves quite interesting. It is a round dial with a series of figures representing different amounts and swept by a pointer. This is actuated by a tappet connection from the rear axle when the hack is in motion, and by clockwork when it is standing in the service of a customer. The pointer is controlled at four different speed ratios—the first for daytime service for one and two persons; the second for daytime service and three and four persons; the third and fourth similarly, but for night or suburban service. The tax is so moderate that anyone whose business is at all urgent prefers to engage them to taking the cars or omnibuses. On engaging the hack, the driver pulls up and out of sight the "empty" placard, and by so doing throws the taxameter into action and prominently displays a number indicating to the passenger the rate under which he is traveling. The initial position of the pointer is at 50 pfennig (12½ cents), then for every 2,000 feet traveled the pointer jumps ahead 2½ cents' worth. One involuntarily gets to watch the jump of the pointer and to speculate whether or not he will get the best of the driver by riding the final 1,950 feet free. While standing the clockwork acts on the mechanism at the rate of four minutes as equivalent to 2,000 feet travel. These are the No. 1 rates. If one has a trunk or other large parcel, the driver takes that at an additional 6¼ cents.

Persons in not much of a hurry, or of a more economical turn of mind, will take either a car or an omnibus. With both styles of vehicles there are different rates of fare, according to the distance traveled. A ticket is invariably given as a receipt for cash fare, which it is well to retain, as occasionally an inspector comes around and goes through the car, looks at the tickets and returns them after having torn off a corner. On some of the omnibus lines the fare is as low as 1¼ cents. One of the electric lines also provides for the entertainment of its patrons en route, by placing a file of the day's papers on a rack conveniently situated near the car roof. Travel in the various street car lines is rather slow, as, though many and very fine electric cars are in use, the pace is regulated by the horse cars sandwiched between. It is also very annoying to attempt boarding car after car only to be refused admittance because it already has its legal quota. The conductors are very strict in the enforcement of this rule, as the police will mulct them in a fine if they are caught with too many passengers. Three types of electric cars are in use—the overhead trolley, the underground trolley and the accumulator car. Some lines use the trolley for the greater part of their run, and then through the business portions of the city take current from secondary batteries carried under the car seats. The trolley is quite different from ours, and of a style that makes the phrase "off his trolley" quite unintelligible to the Berliner. It is in shape not unlike an inverted lyre, with the top bar bearing against the wire, so that in rounding curves the bearing simply shifts along this bar, but is never lost.

A WONDERFUL PISTOL.

One day we had the pleasure of a call from the inventor and constructor of the Borchardt repeating pistol that was described and illustrated in the "American Machinist" some time ago. This may be remembered as a most ingenious weapon, whose main characteristic is that it is self-acting, like the Maxim gun; the energy for extracting the shell and reloading being derived from the recoil of discharge. The grip is arranged just about under the center of gravity, so that accurate aiming is much easier than with the old-fashioned type of revolver. It is really a quite simple piece of mechanism, and though extremely accurately fitted, is yet not at all delicate, as has been proven by its successful passage of the extremely rigorous test of the United States army experts and the recommendation for adoption by the Small Arms Board. This is also one of the evidences of enterprise of the Loewe concern. Possibly the most remarkable thing in connection with this altogether remarkable arm, and one that is a notable triumph for its inventor, is contained in the statement from Mr. Kosegarten, a director of the Loewe Company, that the weapon as manufactured to-day is in every respect like the first model turned out by Mr. Borchardt, who can thus point to a

record rarely equalled, of an absolutely novel invention perfected without the usual tentative and corrective processes. Some share in this achievement may be credited to this country, as Mr. Borchardt gained the bulk of his experience in this line in Hartford and Frankfort.

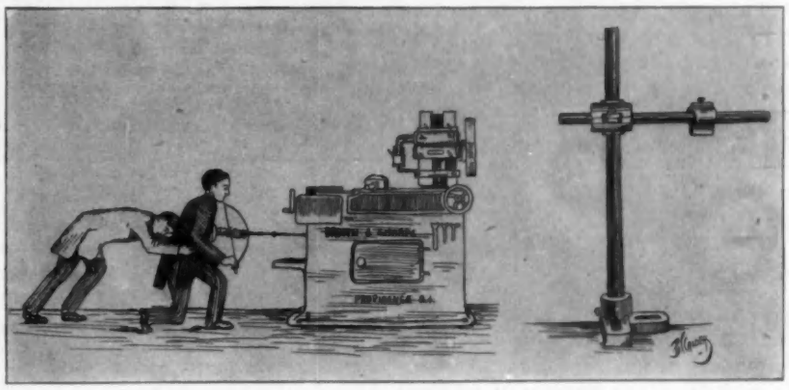
It would give me much pleasure to describe many of the new and interesting features of those noteworthy shops, the new Loewe factories; but from a remark recently dropped in an editorial I believe that Mr. Miller already has a full account of them in store among his many other good things. Later on, when the shops of Die Deutsche Niles Werkzeug-maschinen-Fabrik are in operation, there will be something of interest in that connection. No doubt that name will recall Mark Twain's notes on German to many, but like a good many unfamiliar things, it is really not any worse than our own. Word for word, it is in English "The German Niles Machine Tool Factory," which is every bit as long, and yet not at all terrifying.

A JOB OF DRILLING.

Mr. Crocker, of the Niles Tool Works Company, and one of our party, brought home from a side trip to Belgium an interesting little sketch that is quite too good to be lost. It represents an actual occurrence noted in a prominent Belgian tool shop, and certainly does speak well of the spirit of mutual good-will and readiness to lend a helping hand (or head) prevailing among the boys of that establishment. This shop was adopting modern methods and numbering its machines. The young men were caught in the act of drilling for the number plate with an evidently dull fiddle-bow drill. The companion sketch shows the evolution of the rear young man into an "old man." The sketches are due to the budding artistic genius of an office boy in the Niles advertising department, to whom all inquiries as to the why of the double stovepipe and teapot saddle are to be directed.

AN EXPERIENCE IN A GERMAN SHOP. SALESMAN.

An experience had in a South German shop was very typical of generally prevailing conditions. A large concern there that builds anything and everything was kicking about a lathe, claiming that it would not work without chatter. Taking a trip down there a long 8-inch piston rod was found in the heavy 60-inch lathe, being nibbled at by a light tool projecting about 4 inches from the rest. The tool was held by two posts and underlaid with a ½-inch piece of bar iron that, however, only reached to about the center of the second post. All of the various joints of the compound rest were so lightly set up as to convert them into more or less efficient pumps that sent out oil with each chatter. And the workman swore by all that was holy that the bearings were out of round and loose; that the face plate pinion kicked back, and all sorts of other things. Putting in a good stiff tool, with next to no overhang, tightening up the rest to just slide freely, and setting it to work on a chunk with a feed and depth of cut that straightened out the belt, convinced the boss that the lathe was all right, and reduced the man to a kick about the absence of chuck jaws in the face plate. After explaining to the owner that the work he wanted to do that way could be much more advantageously handled by a small boring and turning mill—a tool of which he had just a bare recollection of having heard—he ordered one. Now, this was no small, little backwoods shop, but quite a large concern, employing over five hundred men, and run by a man quite ready to take up new things if they could be shown to be worth while, and yet it was possible for an obstructive and prejudiced workman to seriously inconvenience the builder of a thoroughly first-class tool. There is still a large field of this class to be tilled by the enterprising salesman with actual shop experience. No kid-gloved, pot-hatted agent will do, unless he is ready to lay aside his fine duds and get his hands into the grease and has the ability to operate his wares and talk genuine shop. The "American Machinist" makes a fine *avant-courier* for such an one, to the extent that it circulates there.



THE YOUNG MAN AND THE "OLD MAN."

MORE ABOUT GERMAN TRAVEL.

This trip to South Germany gave me a further insight into some of the delights of travel on German railways. There are only three trains out of Berlin in the direction wanted, and every available thing was taken up in these except one first-class berth in a sleeper of the Italian express, the so-called train *"de luxe."* The luxury was all on the side of the company. First, a first-class ticket cost a deal more than a second-class, without any compensating advantage, unless satisfaction were derived from the name of the thing. Then there was another charge of about double American rates for the sleeping berth. Then there was an added charge for the *"de luxe"*; and, to cap all, another for the privilege of occupying a seat, but without the option of not taking it. But, hold on, that was not all. I bought the ticket not at the station, but in the city, and had to pay extra for the privilege of waiting there for quite half an hour while a half-dozen clerks unwound a spool or two of red tape. The cars were of the compartment type, with side aisle and a lavatory common to every two compartments. But the lavatory contained neither water nor towels, not even a "Waaren Automat" that for an extra charge would dispense these articles. There was, however, a washbowl full of cinders, and a most candid array of all the various utensils needed to keep the place clean, all evidently carefully preserved by non-use.

At Heidelberg there is a very interesting mountain railway to save asthmatic visitors the steep climb up to the beautiful old castle. There are a number of similar ones throughout Germany. The incline is very steep, varying from 30 to nearly 60 degrees with the horizontal. Only two cars are used. Arranged under the floor of each are two long cylinders, open at the up-hill end. The cars are connected by a cable. The car at the top has its cylinders filled with water from two cocks. This supplies the weight needed to pull up the other car with its load of passengers. Arrived at the base of the hill the cylinders discharge themselves into a reservoir, and the water is again pumped to the tank at the top of the hill. Not quite as much is pumped as is taken down, however, because there is a small brook available to feed the upper tank—only the difference between the brook supply and that needed to operate the car has to be pumped back. The line is single track, with a turnout at the middle of the rise, to allow the cars to pass.

GERMAN INDUSTRIAL STOCKS.

But to return to machine shops. With us only the large ones, as a rule, are stock companies; but in Germany not only these but many small ones also are conducted that way; and, contrary to the prevailing American practice, the stock of even the little ones is generally traded in and quoted at the Bourses. One reason is probably

to be found in a rigid enforcement of the laws that prevent all stock watering and the issuance of such public statements of business as to permit anyone interested in the stock to fully inform himself on all phases of the company's affairs. The result is that the stock ratings of concerns doing a good business are hign and stable. Industrial stocks are quite among the best, and are certainly not looked at askance, as are our own, with very few exceptions Among the larger concerns it is a quite general practice to rate the plant very low; one that I know of whose plant is nearly new carries it on its books at just 1 mark (25 cents), although it cost some millions.

A closing word as to the conditions of the German-American machine-tool trade as it appears to me after a few months' acquaintance with it. Ever since the unification of Germany and its consolidation into an empire, no effort has been spared by government or people to bring it into the first rank as a manufacturing and commercial nation; with what result is shown by the continued and growing prosperity of all industries, and also by the rise of a most intense jealousy between it and England where previously no such feeling existed. In these days when every industry calls in the engineer, the machine-tool builders must be favorably affected by such prosperity. This accounts for the fact that every native concern in this line is full of orders for a long time ahead. Americans come in to reap part of the harvest largely because they are willing to promise delivery in shorter time. As the home trade becomes better with increasing prosperity here, the German trade will probably largely fall off with the loss of this advantage. This is quite aside from any question of relative merits; German purchasers have assured me that they would rather buy home product if only they could get it in reasonable time.

Die Construction.

BY GEO. B. PAINTER.

Die makers who have had trouble in duplicating shapes, may find some aid in the construction here shown and described.

Fig. 3 illustrates the simplest form of a bend, a right-angled bend. As far as the bending of the piece is concerned, it is simple; but in making this bend it is necessary that the bend be made exactly in the center of the piece, and that every piece be a duplicate of the first. Will a die as shown in Fig. 1 answer the purpose? My experience is that it will, as long as the point of the punch is sharp and the drawing edges of the die are kept smooth; but after the punch gets dull and the edges of the die get worn, there is no certainty that a die of this form will perform its full duty.

Fig. 2 shows a die that has been found to overcome the difficulty to a very large extent. While its first cost is more, it is more than compensated for in the uniformity of the work and the life of the die. *A* in Fig. 1 represents the punch used in both dies. *B*, Figs. 1 and 2, are the dies. *C* represents the gages, and *D* the piece to be bent; Fig. 3 represents the finished piece. Fig. 2 shows the die slotted out

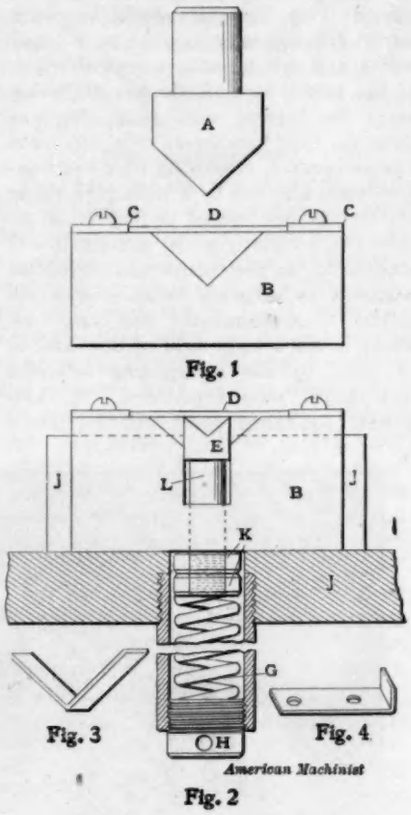


Fig. 2

DIES FOR RIGHT ANGLE BENDS.

and fitted with a pad *E*, which works freely in the slot. The pad *E* has a round shank *L*, which passes through the die. At the lower extremity of the shank *L* are placed two jam-nuts *K*, which regulate the hight to which the pad is raised. The die-bed *J*, shown in section in Fig. 2, is tapped out directly under the pad, and a brass or iron tube *F* is screwed in; the coiled spring is placed in the tube and the adjustable plug *H* is screwed in. The spring *G* acts on the pad, forcing it upward until further progress is stopped by the nut *K* coming in contact with the bottom of the die. The top of the pad at the points made by the angle should then be on a level with the face of the die, as shown.

I think the action of this die will be readily understood from the description and drawing. In the making of the die, to get good results, the die should be slotted and the hole drilled for the pad, and the pad should be driven in moderately hard before planing the angles. The principle of working a pad in a bending die is productive of excellent results, and should be used in all cases where the nature of the work will permit. In the piece just described, the bend was made in the center of the piece, which allowed the die to be made with both sides at 45 degrees to the face.

Fig. 4 shows a blank in which the distances of the bend from the ends are in a ratio of about 4 to 1. This necessitates the changing of the angles in relation to the face of the die. It is obvious that this bend could not be made satisfactorily in the die shown in Fig. 1. While it might be accomplished in the die shown in Fig. 2, the chief difficulty would arise in gaging the piece, and it is manifestly better to change the angles.

Fig. 5 shows us one way to make this die. Fig. 6 shows us a better way, which is to apply the principle of the pad. In both cases, as in the previous example, the same punch can be used.

The relation of the angles to the face of the die is not imperative, but it is regulated to a large extent by the ratio of the distances of the bend from the ends. In the example, the long angle should be 80 degrees and the short angle 10 degrees from the vertical. Fig. 4 shows the blank as having two holes pierced in it. These holes we will utilize to gage the bend, as

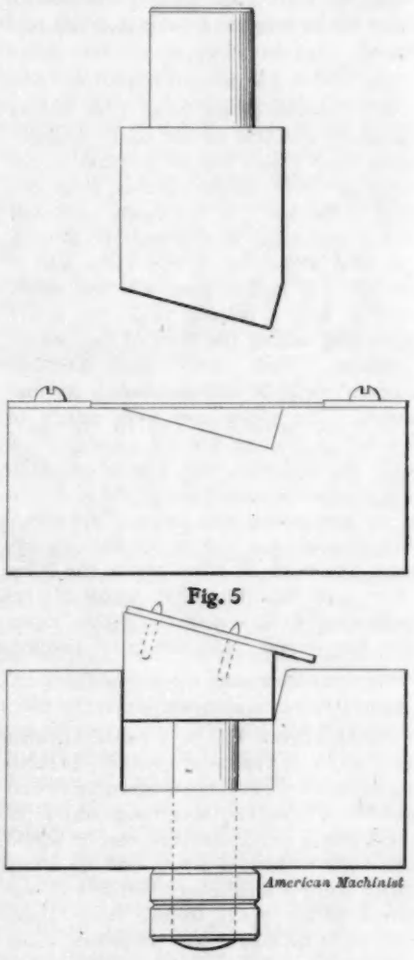


Fig. 5

Fig. 6

FOR BENDING TO PRECISE LENGTHS.

shown in Fig. 6, where the piece lies on the pad before bending. As there are two holes in the piece, we put two pins in the pad to correspond, care being taken to locate the pins correctly. The use of the pins necessitates drilling clearance holes in the punch, as the pins should project through the blank and be pointed. If you bend ten thousand blanks in this kind of a die, you may feel confident that the last one will be a duplicate of the first one.

There is another way in which pieces of the type of Fig. 4 may be produced

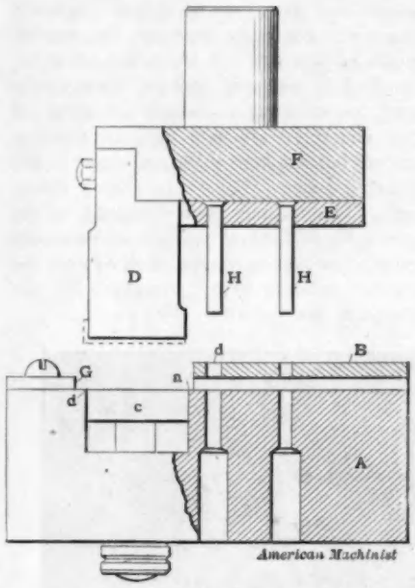


Fig. 7

COMBINATION DIE FOR PUNCHING, SHEARING AND BENDING.

advantageously. The punching shown in Fig. 4 is a piece of metal whose sides are parallel, is bent at right angles, and has two holes pierced in it. In work of this type it is not always necessary to make a blanking die. Fig. 7 is a sectional view of a combination shearing, piercing and bending die to produce this class of work in one operation. In this illustration *A* is the die, having a stripper gage *B*, which must be slotted sufficiently wide to allow the material of which the piece is to be made to slide through easily and still not have any side motion. The strip of material is entered in the slot of the stripper gage *B*, and the end is brought to the cutting edge of the die at *a*. The punch-holder *F*, having the shearing and bending punch *D*, and the punch-plate *E*, carrying the piercing punches *H*, is allowed to enter the die, piercing the two holes. When the punch rises the strip is moved along until it brings up against the stop *G*, and after the holes are punched in the end of the strip the movement is continuous, producing a complete piece at every revolution of the press, of the shape shown by the dotted lines on the bottom of the punch *D*.

The principle of the coiled spring may be applied if the metal to be bent is not too heavy. If the material runs over No. 16, B. & S. gage, soft rubber should be used under the pad *C* for a spring. Of course on the temper of the metal depends the amount of tension which will be needed between the pad *C* and the punch *D*. There must be sufficient tension at this point to prevent slipping while the blank is being drawn over the edge *b*. In ordering the material to work in a die of this kind care should be taken to specify that it must be straight and to the exact width. As far as possible the holes, which are in most cases punched in blanks, should be utilized in gaging for the subsequent operations to which they may be subjected. It helps to keep the work uniform. In the class of dies which I have just described it is necessary that the length of the blank and the distance between the cutting edge of the die *a* and the small hole *d* be known to a certainty before locating either the small holes or the stop *G*. After the small holes are punched, while the length of the blank may be changed by altering the stop *G*, it is done at the expense of throwing the holes in the finished piece out of position. In making the die, therefore, proceed to make the die and the punch, with the exception of the small holes and the stripper gage on the die, and the small punches. All other parts may be finished with the exception of tempering.

Fig. 8 is a sectional view, enlarged, of the finished piece produced by the die in Fig. 7. The distance *M* is fixed, and is the measure for our shearing and bending punch D. The distance *N* is *M* plus the thickness of the material, and is the measure for the die between the shearing and bending edge. The distance *x y* is the

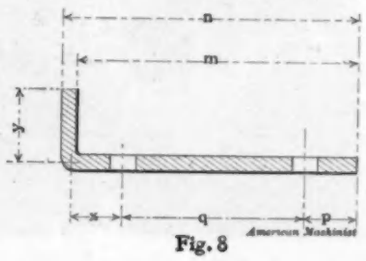


Fig. 8

one we must have to locate the small hole *d*, and is the measure which is problematical. To find this distance proceed as follows: After finishing the die with the exception noted in the previous paragraph, put it, together with the punch, into the press with a blank of any reasonable known length, having holes drilled in proper position, placed between the punch *D* and the pad *C*, and bend into shape. The proper position for the holes is the distances *p q*, Fig. 2, and is shown by the finished sample or drawing which we are working from. As we knew the length of the piece before bending, all that is over the measure at *y* is to be deducted from the length which we started with, which will give us the true length of the blank. After deducting the distances *p q* from the true length of the blank the remainder is the measure of the small hole *d* from the shearing edge *a*. This method of finding the length of a blank which is simply sheared from a strip and bent into shape can be applied in a great many cases, and gives the correct solution in one trial. After finishing the small holes in the die, drill and tap the screw holes for the stripper, also drill the dowel-pin holes and temper before finishing the stripper or transferring the holes for the small punches. The automatic feed described by me in issue of "American Machinist" of February 23, 1899, can be applied to dies of this description, if the production is large enough to warrant it.

Filing Drawings by the Size of the Sheet—Book and Card Drawing Indexes.

A common criticism on methods of filing and indexing drawings is that, while perhaps well suited to the conditions where they are used, they are not adapted to other conditions; that every shop must devise its own system to suit its own conditions, and that little can be learned from the practice of others. We are far from saying that there is not in general a considerable measure of truth in these objections, but it so happens in the present case that, so far as the system of filing is concerned, essentially the same system is used at the works of the Southwark Foundry & Machine Company, of Philadelphia, and at the works of the Brown & Sharpe Manufacturing Company—two shops in which the work done represents two extremes in the conditions to be met. In the one case the work is of moderate size and is reduced to a strictly manufacturing basis, whereas in the other case the largest constructions are undertaken—most contracts being special ones, and the same piece of work being seldom repeated. If the same system is adapted to as widely separated conditions as these, the presumption is that it is equally well adapted to intermediate conditions. It should be remembered, however, that this correspondence of methods relates to the *filing* only, the methods of *indexing* being entirely different.

The fundamental feature of this system lies in the filing of the drawings by the size of the sheet and not by the title. The indexing is, of course, by the title, the index card or book giving the size of the sheet and its location among others of its size.

In the Brown & Sharpe drawing office drawings, are classified as *A*, *B*, and *C* drawings. *A* drawings are those belonging to the regular line of product which represent current practice. They are usually made on bond paper for blueprinting direct, though many, in the case of reproductions from old drawings

with slight changes, are tracings. *B* drawings are those for jigs and special tools, and for other work which will not be repeated. They are made on cheap paper, and are sent directly to the shop without tracing—often without inking. *C* drawings are out-of-date drawings of the regular product, or of special work made for the works or for other parties. The size of the sheet is indicated by a prefix to the letter, designating the class. Thus *1A* represents the small size *A* drawings, *2A* the medium size, and *4A* the largest size, and the same classification of sizes applies to the *B* drawings. The *A* and *B* drawings are filed in a set of drawers—each class having separate drawers—while the various sizes of sheets have drawers of proper size. Each drawing carries its size number and its class letter, followed by its serial number. Thus *2A* 1,476 means drawing No. 1,476, class *A* and size 2. The drawers hold 150 sheets each, and carry a label of the class and size of drawings for which they are intended, and the numbers of the sheets within them. Thus the first *2A* drawer is labeled 2A 1-150; the second, 2A 151-300 and so on. The size, class and serial number of any drawing being known, its location is at once indicated, and the card index, arranged alphabetically in accordance with the titles, gives this location. To assist in finding the proper card, those belonging to the *A* drawings are pink, while those for the *B* class are white. For the *C* class the cards are white with a black upper right-hand corner. The form of the card (actual size 2 by 5 inches) is shown in Fig. 1. The "time number" is the symbol by which the machine is known in the shop and to which all charges for time and stock are made. The title gives the actual descriptive title of the drawing, and by this title the card is alphabetically indexed. Part of this title is a sheet number for the set of drawings of the machine to which the drawing indexed belongs—this set number being additional to the continuous serial number already mentioned. The space at the lower right-hand corner of the card is used for other headings under which the sheet is indexed—cross entries being freely used to assist in finding what is wanted. The object of inserting here the various heads under which any given drawing is indexed, is to insure the removal of *all* the cards for a drawing, in case the drawing is removed from the filing cases. Higher, or catch cards, are liberally used to sub-divide a given lot. Thus under "Arbors" will be found catch cards for such classes of arbors as miscellaneous, gear cutter, grinding, milling, etc. It will be seen also that any part which is used on two sizes of machine is completely provided for by providing index cards for each machine to which it belongs.

TIME No., OR NAME AND ADDRESS. **DRAWING INDEX**—BROWN & SHARPE MFG. CO., PROV., R. I

TITLE.

MARKED INDEXED UNDER HEAD OF

REMARKS.

FIG. 1. INDEX CARD FOR DRAWINGS.

FIG. 2. CARD FILE FOR DRAWING INDEX.

The record of the changes made in the same machine from time to time is made by preserving the blueprints from each lot of machines. The building of a lot is found to impose about all the duty on a set of prints of which they are capable, and with the completion of each lot the prints from which it was made are called in and are then placed in a special file used for this purpose only, this file being in a separate building and in a fireproof vault. This vault is called the fire record, and preserves a complete record of all machines up to the lot actually in the works, even should the regular drawing office be destroyed by fire. Each set thus filed is marked with the serial numbers of the machines built from it, and is then indexed by a single card, which is marked as belonging to this class of drawings by having the upper right-hand corner in red. In this way a complete record of all changes is kept, the drawings for any machine built in the past being easily found and positively identified. Discarded drawings, representing the old style machines, and drawings of special machines which are not to be repeated, are treated much as the sets of blueprints—that is, bunched in sets and indexed by a single card for each set, although drawings of this character are not filed in the fire record, but are kept in special cases in the drawing office. These are the *C* drawings. The tracings and drawings in the active file will thus be seen to represent current work only, the record of the regular product being preserved in the blueprint fire record.

The object of bunching the old drawings and blueprints and indexing them by a single card, is to reduce the size of the card index and save labor in writing cards. Drawings of this class accumulate to an enormous extent, and the use of a card for every sheet would seriously encumber the card files. At the same time such drawings are needed for reference with comparative infrequency, and the plan adopted enables them to be readily found when wanted. As it is, thousands of cards are necessary. These cards are not filed in the customary narrow drawers, but in the large shallow drawers of the regular cases. The

rods for keeping the cards in place run across these drawers at suitable distances, and when the drawer is opened a great quantity of cards lies exposed to view—a plan which has obvious advantages over the use of the customary numerous narrow drawers. Fig. 2 is from a photograph of this card file.

In works of such magnitude, it is found desirable to keep a record of the drawings sent from the drawing office to the different departments or outside, and for this purpose for the blueprints made from *A* drawings a special card file is used—a sample card being shown in Fig. 3. Here as elsewhere the word "Time" means the shop symbol to which the time is charged. As before stated, each set of drawings for a given machine has a serial number running through the set in addition to the grand serial number by which it is filed. The set numbers of a lot of drawings sent to any foreman are checked off on the number list at the top of the card, and the date, foreman's

TIME.....

DRAWING NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59

NOTE STYLE OF DRAWING.	INK DRAWING	PENCIL DRAWING	SKETCH	BLUE PRINT,		DATE DELIVERED.
WHITE PAPER.				NOT MOUNTED		
BUFF "				MOUNTED ON CARD BOARD.		
SECTION "				MOUNTED ON WOOD.		189
BOND "				DELIVERED TO MR.		
TRACING "				FOR MR.		

RECORD OF DRAWING SENT FROM DRAWING ROOM.

Report if not returned within a reasonable time, or if soiled or mutilated in any way.

FIG. 3. INDEX CARD FOR DRAWINGS IN THE SHOP.

name, and other particulars are entered. The card is then placed in the file and remains there as long as the drawings are out of the office. When all are returned the card is destroyed. One of the advantages of this plan is that it insures that all the prints of a set are returned for the fire record, or if any become lost, the fact is made known and duplicates can be made to insure the completeness of the fire record. For the *B* drawings a different method is found preferable. The drawing-office clerk has a small blank book, one page of which is given to B numbers from 1 to 1,000, the next from 1,001 to 2,000, etc. These drawings are entered in this list by their numbers, against which is given the initials of the foreman to whom they are sent, and when returned the entries are checked off. The advantage of this plan for this class of drawings is that a large number of drawings can be charged in a small space, and once having the index number the whereabouts of the drawing can be found by looking over a comparatively short list of numbers. Of course, this class of drawings is ordinarily sent to the shop but once, while prints from the *A* drawings are sent out for each lot of machines.

One further regulation should be noted. The filing and indexing are in charge of one individual, and no one else is allowed to put a drawing in a drawer. The draftsmen may freely remove the sheets from the drawers as needed, but when through with them they do not replace them, but put them where the office clerk can find and re-file them. The purpose of this regulation is to fix responsibility for correct filing, and so insure that the drawings, if in the cases at all, shall be where they belong, as on this depends in large degree the success of the entire system.

At the Southwark Foundry the system of filing is essentially the same. The sizes of sheets are designated by letters *A, B, C,* etc., and the drawers belonging to each size are serially numbered, while each sheet has a definite place in its drawer. Thus the index entry 6*A* 18 means that a tracing having a given title will be found in the sixth *A* drawer, and that it is the eighteenth tracing in that drawer. At this point the correspondence of the two methods ceases. The index at the Southwark Foundry is a book index, and groups all the sheets belonging to a given machine under the name or title of that machine. The catch entry is the name of the machine, and below it are entered the titles of all the drawings belonging to that machine, the title of each sheet being followed by such an entry as the sample 6*A* 18 given above, whereby its location in the filing case is at once pointed out. This plan, like the Brown & Sharpe plan, makes no effort to keep drawings of a class together, and the various sheets belonging to a given machine may in fact be widely scattered in the cases, but, their titles being grouped together in the index, they are very easily found.

One of the marked advantages of this plan lies in the facility which it gives for the use of the same drawing in different machines. It is here that the plan of placing all drawings of a given machine in a drawer together finally breaks down. That plan works well enough until some new machine, made up partly from parts belonging to others, has the floor. With the Southwark plan such cases are met by simply entering the title of the old sheet under the new heading and repeating the entry showing its location in the filing case.

As so far described, the system lacks one necessary feature, in that standard parts used in numerous machines, such as throttle valves, fly-wheels, etc., are distributed through the cases, whereas they should be so grouped as to permit of ready reference for comparison. This is accomplished by making office blueprints of such parts and binding those of a kind together. These bound files are kept in the office for ready reference, and when a draftsman requires such a part for a new machine he consults its bound file, takes out the file-case entry belonging to it, and enters that entry in the list of drawings for the machine he is working on. The system has been adopted after long experience with others, and is found to meet the requirements better than any other which has been tried.

It has often been remarked in these columns that any description of an office system always seems more cumbersome in the description than it is in fact. As regards the present plans, no one can see them in use without feeling that all of their provisions are needed and that they accomplish their objects with a very trifling amount of clerical labor.

Taken together, they seem to meet the most diverse conditions. It will be seen that, at bottom, the principle underlying both is the complete separation of the filing and indexing functions. The failing point with the common method lies in the attempt to make the file answer the purpose of an index. This does well enough for a time, but as drawings accumulate, the indexing feature is found to be inadequate and a book or card index is added, but usually as an annex to the existing method, the complete separation of the filing and indexing functions not being attempted. With these plans the labels on the cases of drawers give no clew whatever to their contents, which must be sought in the index, and it is in this common feature that the merits of the two plans lie.

The list of machine parts which can be purchased in the market ready made is being extended in various directions, and the latest addition to it, perhaps, is in the form of racks to be used in machine tool construction, etc. These racks are of cold drawn mild steel, accurately formed, and are ready for application to lathes, drills, presses, etc.

Machinery in Brazil.

Mr. Henry White, Secretary of the United States Embassy at London, recently sent to the government at Washington copy of a report by Mr. Worthington, Commissioner of the Board of Trade to South America, on trade conditions in Brazil, and of this report we print that portion which relates more particularly to machinery in that section of South America:

"The majority of stationary engines seem to be of British make, but the reverse is the case with regard to locomotives. The reason alleged for the latter being chiefly American, is that the Americans make the most suitable engines for poorly ballasted and new lines; and I have been told in proof thereof that some of the smaller lines, which formerly used British locomotives, have taken to Baldwins. I am not satisfied that the reason alleged is the correct one, nor that it is a fact; not being an expert, I cannot say authoritatively, but what I saw and learned in the Argentine seemed to show that the United States makers are not alone successful in building locomotives for new countries, and, curiously enough, some very fine American locomotives which were imported here a few years ago proved too heavy and rigid for the road. It seems to me that one great reason of the success of the Baldwin Company in capturing the trade, is their admirable local organization. They have good influential agents and also several engineers of the company always on the spot where they are needed, to attend to complaints, remedy defects, and watch for new requirements. Their locomotives are light and cheap to make. They have a business in the country, so that they can afford to incur expenses in protecting and extending their trade, as well as to sell on very long credit, and yet accept what seem to be moderate prices.

"Probably the machinery of largest sale in this part of Brazil is that which has to do with the cleaning and preparing of coffee. This is very largely made in the country. For general agricultural machinery there is not much demand, coffee being practically the one crop of the country; but there are evidences of a change having begun in this respect.

"In electric machinery the American make has by far the largest sale. It is worth noting in this connection that there is an American electrical expert here, with electrical experts under him, who is well backed by a big American company. He has a shop in the leading street of Rio de Janeiro to show his wares, and is, I am assured, the only man in the place who is prepared to estimate at once for an electrical installation anywhere in the country; others have to write to principals. It is not surprising that, quite apart from considerations of suitability and cheapness of machinery, he does the most business.

"Pig and puddled iron are imported principally from England. There is a considerable amount of casting done in the country—only large pieces being imported—and the industry is protected by a duty of 200 reis per kilogram (3.45 cents per 2.2046 pounds) on plain castings, 400 reis (6.9 cents) on painted or tinned, and 1 milreis (17 cents) per kilogram on gilt or silvered, against 10 reis per kilogram on pig iron.

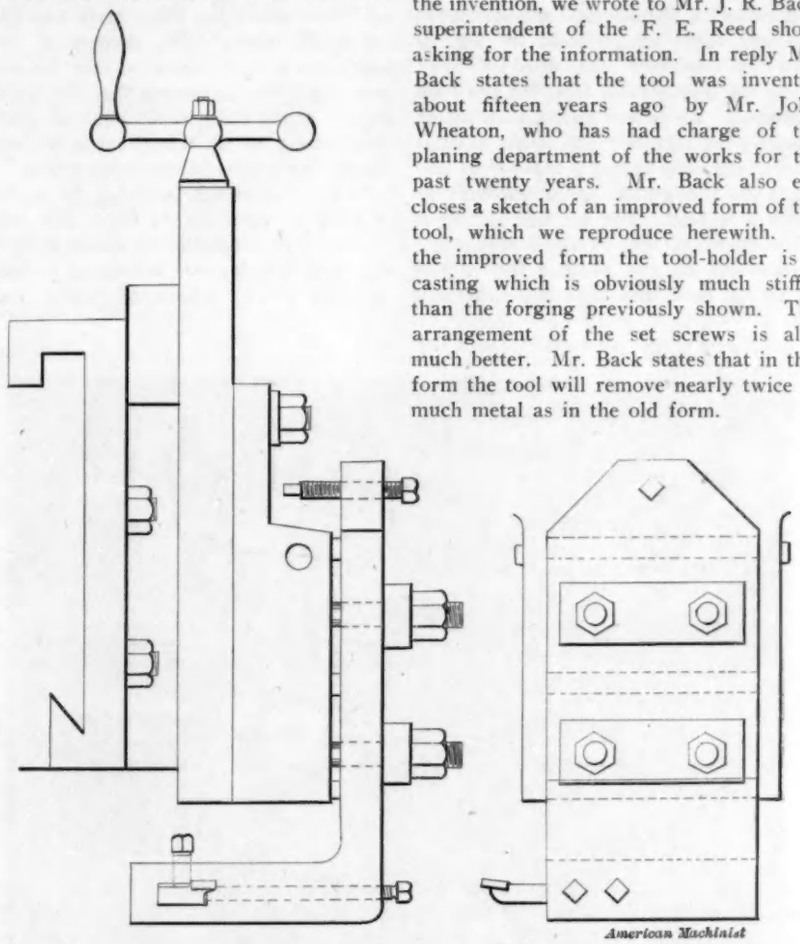
"The demand for bar, angle, bolt and rod (including soft steel) is principally confined to the smaller sizes. Bars for up country have to be bent into 5 or 6-feet lengths for packing on mules, and the bending is largely done here. The iron used is often Swedish, which, notwithstanding that its test is much higher than English or Belgian, is preferred in the interior, because, after it is worn out in its first use, it serves for making into knives, etc., locally.

"Wrought-iron building girders have not hitherto been largely imported, but their use will doubtless increase, and Belgium is to the front with cheap prices.

"Iron pipes, both black and galvanized, used all to come from England, but now the United States is a strong competitor; while in regard to cocks, joints, T's, etc., it is said to be only because people are accustomed to English shapes, that so many still come from England. A large importer here told me that the United States makes were lighter (duty is by weight) and cheaper, and he looked forward to buying in the United States later on."

The Undercut Planing Tool Holder.

In connection with a suggestion by Professor Sweet that the inventor of the undercut planing tool holder shown in our issue of March 16, should have credit for the invention, we wrote to Mr. J. R. Back, superintendent of the F. E. Reed shops asking for the information. In reply Mr. Back states that the tool was invented about fifteen years ago by Mr. John Wheaton, who has had charge of the planing department of the works for the past twenty years. Mr. Back also encloses a sketch of an improved form of the tool, which we reproduce herewith. In the improved form the tool-holder is a casting which is obviously much stiffer than the forging previously shown. The arrangement of the set screws is also much better. Mr. Back states that in this form the tool will remove nearly twice as much metal as in the old form.



IMPROVEMENT IN THE UNDERCUT PLANING TOOL.

In connection with the article of March 16, we have received the following letter:

Editor American Machinist:

In your article "An Undercut Planing Tool Holder," which gives credit for the same to the F. E. Reed Company, there must be some mistake. This tool-holder has been in constant use in P. Blaisdell & Company's shop since 1868. The writer first saw it on an old wooden bed planer used by the Cleveland Machine Works, and requested Mr. P. Blaisdell to allow him to make one like it. Mr. Blaisdell gave his permission, and the tool has been in constant use in this shop ever since. E. P. TAFT.

Worcester, Mass

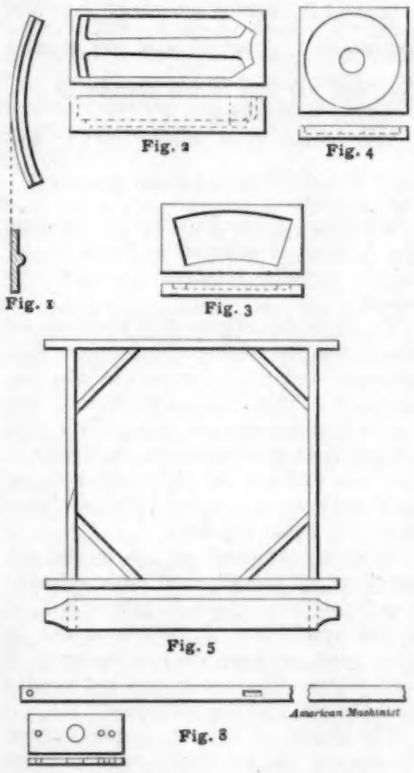
This is apparently a case where two men have invented the same thing.

Letters from Practical Men.

Making a Pulley at Argentopolis.

Editor American Machinist:

Some days ago the Furnace Iron Works had a contract to make a friction pulley 8 feet 6 inches diameter, 10-inch face, 4½-inch bore, rim 1¼ inches thick. The best price Sam Better, the superintendent, could get was $110, which was a little cheaper than it could be freighted from St. Louis. So Sam had a rim segment pattern made something like Fig. 1, an arm core box like Fig. 2, a flat core box for rim covering cores like Fig. 3, and one for the hub covers like Fig. 4. Then a cheek flask was made like Fig. 5 and the molder began business. An old sweep-spindle and base were found, and after ramming up a bed one of the cores from Fig. 4 was set central with the spindle and the bed was swept flush with the top of the core. Then the arm cores, which also formed the hub, were set on the bed by marks giving six equal spaces. The cores were set equal distances from the center by using the sweep; the cheek flask was then put on the bed, and eight strong stakes were driven, two at each corner, to serve as guides. The segment



PATTERNS, FLASK AND BORING BAR FOR THE PULLEY.

pattern, Fig. 1, was then set up against the ends of two cores, and that part of the cheek and the space between the two cores were rammed up. After ramming, the pattern was rapped and drawn around some distance past one of the cores, then rammed from both sides as before. It was then rapped and drawn around to the next arm core and rammed, and so on around. When the last space had been rammed the cheek was hoisted off and the pattern was taken away. The upper surface of the cheek and the spaces between the arm cores were swept off as fast as they were rammed up. The cheek, after finishing it and the inside of the rim, was replaced on the bed and the hub and rim-cover cores were put on, several inches of

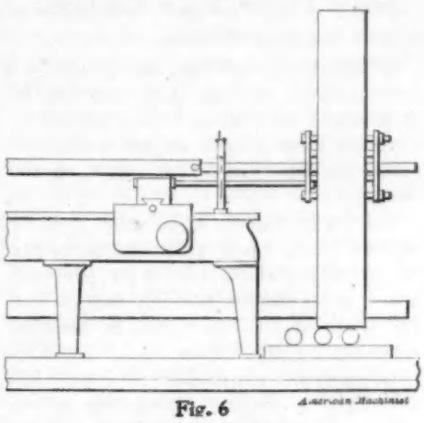


Fig. 6

BORING THE PULLEY.

sand was rammed over them, and the whole then well weighted with pig iron. Basin and flow-off gates were made, and the mold when poured produced a very respectable casting, considering the facilities at hand.

The largest lathe in the machine shop was 30 inches swing, and although it had a gap of curious shape, produced by cold chisels at various times, it wouldn't stretch to receive this pulley. Sam found a boring bar and two plates, something like Fig. 8, and setting the pulley horizontally on a pair of horses he bolted the plates one on either side of the hub with wooden blocks about 1½ inches thick under them, and with the bar in place in the center holes and its lower end resting on the floor, he put a piece of ½-inch round iron in the hole near the end of the bar, and using it as a tram, set the bar true with the edge and face of the pulley by knocking the plates to the proper position. After the plates were wedged or "shimmed" so that the bar turned freely, and the bolts were well tightened, the pulley was set up on gas pipe rollers at the end of the 24-inch lathe, and the footstock having been removed, the end of the boring bar was supported by the steady-rest. The bar was rotated by an old boiler tube held by one end in the lathe chuck and driving the bar by the slots in the other end of the tube engaging a ½-inch pin driven through the end of the bar. A scrap of 3-inch pipe put through the lathe legs and between the pulley arms prevented the pulley from turning, and the feed was accomplished by a rod with a nut on either end passing through one of the plates, then through the steady rest and through the tool block of the slide rest, and a nut and washer on the end, thus drawing the pulley toward the lathe by the carriage feed. This rig looked something like Fig. 6.

For turning the pulley, the scrap pile furnished several important pieces used in the rig shown in Fig. 7. The main shaft, 4½ inches diameter, with gear 5 feet diameter, 4-inch face keyed on, and the countershaft, with 6-inch pinion keyed on its end, were taken from an old hoisting rig, and the pulley, after chipping and filing its keyway, was put on the hoisting shaft and a concave key fitted. The large gear had a clutch arm projecting near its rim, so as to catch an arm of the pulley and make a first-class driver. The bed of the lathe for turning the pulley consisted of two pieces of 4x8-inch soft pine, "toe-nailed" to a pair of horses. The slide rest was the Putnam planer cross-rail and tool-slide, clamped to the 4x8-inch pieces with planer clamps and bolts, and resting on the wooden journal box of the countershaft. For all the journal boxes pieces of soft wood were merely notched, not cut to the circle; but for the main boxes a piece of soft pine, 1x4 inches, was sawed at 45 degrees and tacked to the lathe-bed on each side of each main journal. A gear about 18 inches diameter was dug up and fitted to the countershaft, and a 3-inch pinion was fitted to a third shaft about 2 inches diameter. A 36x6-inch

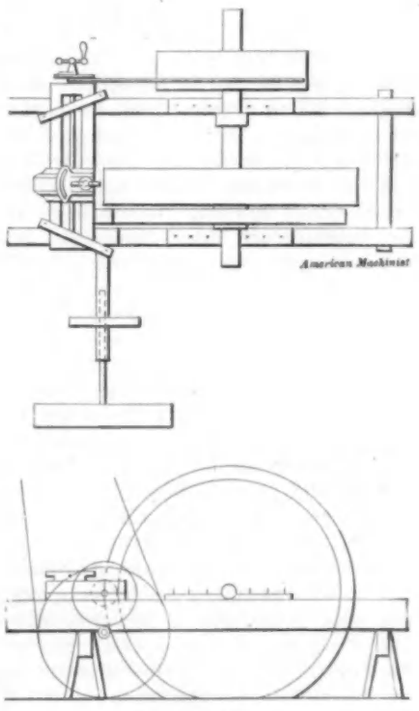


Fig. 7

RIG FOR TURNING THE PULLEY.

pulley, 6-inch bore, was then fitted to the outer end of this shaft by bushing it with two scraps of square iron, and its two good 1-inch set screws on a piece of ½-inch square iron held it firmly. Although

it wobbled perhaps ½ inch or so, there was plenty of belt power with four or five scraps of 3, 4 and 5-inch belt patched together and run from an 18-inch pulley on the line shaft. Sam took off the pawl which operated the horizontal splined shaft of the vertical feed of the planer tool-block and put in its place a stick about 1x2½x60 inches. A board about 1x10x20 inches was then clamped to the main shaft on its projecting end, and the 1x2½-inch stick resting on this board rose and fell twice at each rotation of the pulley. The cross-feed pawl, thrown in gear, thus gave the tool its automatic feed. A longer 1x10-inch board clamped to the shaft gave a wider feed for a light cut. By placing the main driving pinion directly under the slide rest, the frame of the machine was relieved of almost all strain other than that of carrying weight. A post which happened to be convenient was used to carry one of the shafts. The soft wood beneath the cross-rail, yielding, allowed the tool first used to dig and chatter. This was soon avoided by making a hooked tool which took a cut of about ½ inch with 1-16 inch feed without chattering. A second roughing cut with 3-16 inch feed and a finishing cut with ½-inch feed made a very creditable job of the pulley. The total time in the machine shop was about forty hours, which left the firm a neat profit. THE JUDGE.

Amateurs' Foot Lathes.

Editor American Machinist:

Seeing a letter in the "American Machinist," March 9, from C. K. J., on the subject of lathes for amateurs, I wish to say a few words on the subject. The small screw-cutting lathes made in the United States and fitted with foot-power for amateurs and others who have no means of running them, are "man killers." I have such a lathe made by a prominent firm. It swings 9 inches. To use the belt on the smallest speed of cone will take more strength than an ordinary man possesses. Taking an ordinary small power lathe and fitting a foot-wheel to it *does not* make an efficient tool for a person that has to use his foot to propel the same. With the present very easily handled grinding machinery it would not cost any more to put hardened steel bushings in head stock and a hardened mandrel than it does to put in the ordinary long gun metal boxes, and as the steel bearings could be made very much shorter than gun metal only a small fraction of the power would be required to run it.

Then the correspondent speaks of an "overhead," which is the handiest attachment that can be put on a foot lathe. Why some of our makers have not built this attachment I cannot understand. Some will say there is no demand for such devices, but if every inventor should say there is no demand for an improvement and let his ideas die in his own brain, of course there would be no demand; but build an efficient foot-power lathe with an overhead and attachments to be propelled by the same and get up some good descriptive printed matter (the "American Machinist" kind) and advertise through the proper channels and they would make a demand. F. H. JACKSON.

Angelica, N. Y.

Steam Driven Road Carriages.

Editor American Machinist:

In consequence of the considerable attention which my last letter attracted, by letters and otherwise, I am moved to write at more length on the subject of motor carriages, and first regarding the motor.

The electric seems to be most in favor in New York, where great companies can be projected which will never pay, and where great electric currents may be had for charging the heavy storage batteries necessary to this system.

In suburban towns like mine the electric lighting is an alternating system which will not charge anything except the man who fools with it. A neighbor of mine, a dentist, who has lately put in an outfit of small machinery, to be driven by electric current from a storage battery by day, to be charged at night when the town lights are on, has discovered this fact.

In Boston there are some carriages with gas explosion motors which will not mote at unexpected times, and George Whitney's is by far the best of them all, with steam boiler and engines, and able to climb any hill.

Whitney's use of gasoline or naptha fuel makes his carriage very clean and attractive to a prospective buyer. Gasoline can be bought in most any town, and most every town has a gaining list of shocking deaths and house-burnings in consequence of such freedom in its use.

Cumberland coal or picked anthracite is amply good for fuel. From the above you may gather my belief that for pleasure riding, the steam motor is by far the best. I propose a steam carriage rather roomy; weight, with riders, 1,500 pounds; two drive wheels aft, diameter 4 feet 6 inches, circumference 14 feet; one steering wheel forward, 3 feet diameter. Gear or sprocket on each driver, 24 inches diameter. Pinion each end of three-throw crank shaft 6 inches diameter.

Engine—Three equal cylinders, diameter 2 inches, stroke 4 inches. Plain slide valves, with travel 1 inch, lap ¼ inch, opening ¼ inch, cut-off three-quarters of the stroke. Backing gear not needed, and the valves may be worked by lever motions from the other crosshead, the cranks being equally spaced.

Consider the carriage as climbing a hill having a rise of 1 foot for every 10, and traveling at 5 miles per hour.

Then the pull on the drive-wheel rims is $\frac{1500}{10} = 150$ pounds.

The speed in feet per minute is $\frac{5280 \times 5}{60} = 440$.

Then $\frac{150 \times 440}{33000} = 2$ horse-power.

Revolutions of drive wheels $\frac{440}{14} = 31.43$ per minute. Of engine cranks, $31.43 \times 4 = 125.70$ per minute.

Three pistons have each 3 square inches area; then with free exhaust, and using boiler steam in all, the mean may be 100 pounds per square inch, and indicated power 2.3 horse.

The cylinders I have shown, 2 inches diameter and 4-inch stroke, may appear rather small, but it is important to make them as small as we dare, so as to get economy when on level road. With a strong boiler we might get 150 pounds pressure in the cylinders and run slow. This grade, 1 in 10, is the worst of any in my vicinity, but the hills are nowhere more than half a mile long.

The reader must remember that the weight, 1,500 pounds, is only an assumption. If he intends to build a carriage the best way is to actually complete it and put it on the scales before he finally determines the cylinder diameters.

In the hill-climbing calculation each piston moves $\frac{8''}{12''} = \frac{2}{3}$ foot per revolution, and $300 \times 3 = 900$ pounds; $900 \times \frac{2}{3} = 600$ foot-pounds.

Revolutions per minute 125.7, and

$$\frac{125.7 \times 60}{33000} = 2.3 \text{ horse-power.}$$

The surplus .3 may be taken to overcome the friction, in addition to the 2. horse-power actually required to raise the weight.

To work this engine with economy we should use the middle cylinder as a high pressure, and the other two as one low pressure. Then with 130 in the first valve chest we may get 60 pounds in that cylinder and 30 in each low; then we will get 300 foot-pounds per revolution, or half what we got at first, but only one-third the steam expended.

If we try the grade of 1 in 20, the pull becomes 75 pounds, and with ten-mile speed the horse-power calculated will be 2; the revolutions of the engine will be 251.4, and working as a compound, as just shown, the foot-pounds per revolution are 300, and the horse-power 2.3.

The grade of 1 in 20 is the steepest known to me for street railway. For steam roads the maximum is 100 feet to the mile, or 1 in 53.

Finally we will try the grade of 1 in 40; the pull is 37.5; the speed 20 miles; the revolutions 500 and foot-pounds per revolution 150, and the horse-power 2.3, and the engine will get wire-drawn steam.

We cannot assume a dead level road for a steam carriage for trying a high speed.

There is always some yielding in front of the wheels. So the condition is as if the carriage were climbing. All we can do is make our work as light as we dare, and give the wheels a good bearing by large diameter. If we make the wheels too wide we may get stuck in clay.

Taking everything into account, I consider that with a speed of 20 miles per hour the power of the engine will not exceed 4 horse. This it does working under its best conditions, and the weight of steam used may be $35 \times 4 = 140$ pounds in the hour.

The boiler which I propose will evaporate 7 pounds of water per pound of bituminous coal, and $\frac{140}{7} = 20$ pounds, or 1 pound per mile traveled. It is 15 inches diameter, 3½ feet high, with internal furnace 18 inches high; 40 steel tubes, 1 inch diameter, 2 feet high; shell and furnace ⅛-inch thick. It is good for 200 pounds working pressure. The weights are 230 pounds for the boiler and 120 for the water inside. It is mounted on the frame, just behind the drive-wheel axle, clearing the ground a foot, and is protected by the steering wheel.

The engine with its three cylinders lies horizontal at one side and connects forward to the crank axle, which reaches all the way across the frame, with the chain pinions outside.

The wheels are mounted much the same as on an ordinary carriage. The wide rims turned inward give a protection to the chain gearing. A convenient gage is 5 feet between rims, so as to clear street-car tracks.

The frame may be a single piece of 1½-inch steam pipe, bent to a semicircle to form the front. It is mounted on three springs, the two principal ones being on the square part of the axle, which makes it about 2 feet 9 inches from the ground. The third spring is a spiral about 15 inches high, made of ⅜-inch square steel wound to ¾-inch pitch on a 2½-inch mandrel. It is mounted on the stem of the steering gear. The rough firing and oiling can best be done when the carriage is standing.

The water tending may be done by a float inside the boiler which works a spill cock—an old device of mine which makes sure the working of the feed pump at almost any speed. It is a very small cock placed on the feed pipe, which permits the whole or a part of the feed water to pass back to the tank. The tank being above the pump and the supply pipe always open, the pump always gets filled with solid water. The prevailing fault with pump valves is that they are too small in diameter and have too great a lift, as evidenced by the noise and quick wearing out.

The greatest consumption of feed water will be .50 cubic inch per revolution; then a single plunger pump ½ inch diameter and 4 inches stroke gives .75 cubic inch. The valves should be ¾ inch diameter and 1-10 inch lift. They should be placed so as to be easy to get at. The float, if hollow, should have a trifle of water inside to prevent collapse. The steam trap makers in all these years have not learned this simple trick.

This boiler, from its large capacity, will run half an hour safely without any feed at all, and when you come to water you can fill up with the injector.

What I have called rough firing is done through a door at the rear side of the boiler and entirely clear of the body or riding part. Thus the grate may be dropped on the ground and the fire with it and the carriage moved away to avoid injury.

Another part of rough firing is getting ready for a start. You begin with a foot of cold water in the boiler and make a little wood fire on the grate, to which you can add a few clean lumps of Cumberland coal. When steam is up you can start the jet and things will go faster, and there will be no smoke worth considering.

While steam is rising you feed up with the injector, and fill your tank, being sure that the water is clean. If you expect to make a long run you must make up the fire with 20 or 25 pounds of coal, a little at a time, holding up the steam, and not stirring the fire. The result will be that there is a thick pile of green coal in the middle of the furnace, with the fire drawing up around the edge.

You are now ready to start, but if you do not want to start, stopping the jet will stop the steam making. After you start the blast from the exhaust will give you a good fire without smoke, the gas and steam from the green coal only coming away as fast as they can be readily consumed, by the air passing up around the edge of the grate. After a little the green coal swells up to a pretty regular cylinder, perhaps a foot high, and becomes red-hot coke rather porous, and the most perfect fuel in the world. It is safe and smokeless and contains but a trifle of ash, and now and then a slate easy to throw out.

As you go on this cylinder of coke will waste away, and you may want to split it up so as to cover the grate and gain speed. For this purpose a little door at the back end of the body, matching another door at forward side of the boiler, will be useful; but there is no need to bring coal into the body. The water tending you can do yourself inside the carriage, working the spill cock or the injector, or even oiling the engine without making much dirt; and to my mind it is pleasanter to feel the whole machine under your sight and control than to use any form of feed regulator. Soft coal dust and oil ground together on the hands make an unpleasant coating, and there only is where the naptha burners have an advantage.

The drive wheels are made by turning a flange on a circle of steel 1-16 inch thick. The 24-inch chain gear being bolted fast inside will give ample stiffness; and, to deaden the noise, wood may be bolted inside. You might try 3-inch gum belting for a soft tire. The steering wheel comes 5 or 6 feet forward of the drive wheels. It is 3 feet diameter with a 4-inch rim. It it a plain disk of soft steel with a 2-inch flange all around, and the rim is of saw-plate steel, 1-16 inch thick.

The steering wheel is mounted in an upright fork having 2½-inch tubing for its stem, which is slipped on the 15-inch spiral spring which works in compression inside another tube which is firmly built to the frame. This outside tube should have a good length as it has to carry a good deal of a side strain. On its upper end is mounted a worm wheel which, by a stout feather and a slot in the inside tube, swings the wheel for the steering. This inside tube may be also utilized for admitting a screw which works down the brake shoe, which has a bearing on the wheel.

The body may be made of wood and hang down between the frames, so that the floor is 18 inches from the ground, but having a rise so as to clear the steering wheel. It should be carried on gum springs on the main frame in such a way as to cut off the vibration of the metal.

WILLIAM H. HARRISON.

Braintree, Mass.

Shrink Fits.

Editor American Machinist:

Your correspondent, "Glasses," in issue of March 23, asks for light on shrink fits and the operation of shrinking. This topic has been discussed, I know, quite fully in the "American Machinist" in former years, but we have not heard much about it lately, except the paper by Prof. Wilmore, in issue of February 26, describing tests of press and shrink fits, which showed that the shrink fits held about three times as tight as force fits of precisely the same compression allowance. This I was very glad to see, as it confirmed the quite considerable experience which I have had with shrink fits. Although my experience never extended to formal tests of the holding strength of pressed or driven fits as compared with shrunk fits, I had quite an accumulation of the practical everyday tests which filled an extended acquaintance with this line of work, and by the testimony of these tests I always felt safer and surer with shrink fits than with any others, and then the ease with which the thing is done is also greatly in its favor to one of my chronically tried condition, and I cannot understand why machinists generally, with the true machinist's instinct for evading unnecessary exertion, do not universally employ the shrink fit where it is practicable.

"Glasses" evidently meant to tell his story straight and full, but still he leaves much to be desired. His allowance of

about 1-32 inch for the fit is not the kind of measuring that will do for successful shrink fits. I doubt very much whether the actual difference was as much as that, according to his own story of what happened, at least I can't make it figure out right. The temperature Fahr., for a "clear cherry red" is given in Kent as 1,832 degrees, so that if the normal temperature of the job was 60 degrees the temperature was raised by the heating 1,832 — 60 = 1,772 degrees. The coefficient of expansion for cast steel, per degree Fahr., is .00000636. Then 1,772 × .00000636 = .01127, which would be the expansion per unit of dimension; and, as the hole was, say, 2 inches, the actual expansion by the heating should be .01127 × 2 = .0225". But 1-32" = .03125", and as the piece slipped on quite easily, and did not begin to pinch on the shaft until it began to turn blue, the piece must have expanded quite a little more than 1-32 inch, which according to the figures was impossible.

"Glasses," again, does not tell us how the piece was heated—whether slowly or quickly, or whether the hole was heated before the outside or *vice versa*. These things make some difference, I will not say how much, in the final result. In many cases, where a piece is of considerable size, with a comparatively small hole in the center (as, for instance, a steam piston), there is quite a temptation to have a blaze up through the hole, and to heat up immediately around the hole quicker and hotter than the outside. The effect of this might be to change permanently the diameter of the hole. If the metal around the hole should be heated without heating the outside of the piece, the expansion of the heated metal would tend to drive it inward instead of outward, and it would be possible by this means to permanently reduce the diameter of the hole. On the other hand, if the periphery were heated and not the interior, the latter would be placed in tension rather than in compression, and the tendency then would be to enlarge the hole instead of reducing it. The even partial adoption of either one of these modes of heating could not have the same effect in the final condition of a fit shrink as the adoption of the other extreme, and neither could be as good or as safe and sure as a slow and uniform heating of the whole.

"Glasses," finally, does not tell us about the cooling of the job after the piece was shrunk on, and this, in connection with the excessive heating of the piece, I am inclined to think must have been of considerable importance in his case. It is of course desirable to have the piece as tight as possible when the job is done, and it is not done until it has all, the interior as well as the exterior, cooled down to normal temperature, and the mode of cooling must make quite a difference. It is the easiest way, the most natural way, perhaps, to cool the outside of the job first, or, if it is allowed to cool without artificial means being applied, the outside of course cools first. The fit is then at its tightest. If the inner piece is not yet cold, it of course will not be as tight after it has finally become perfectly cool. There seems to be no way to cool a shrink fit without some cooling of the inner piece after the outer, but every effort should be made to have as little of this subsequent cooling as possible, and one way is to avoid unnecessary heating of the piece to be shrunk on. A small allowance for the shrink fit requires less heating than a large allowance, and with the lesser heating there will be also less final cooling and shrinkage of the enclosed piece away from the tight embrace of that which encircles it.

"Glasses" gives us no idea of the condition of the surfaces, either of the interior of the hole or of the exterior of the shaft, where they come in contact; and, in fact, I do not know anyone who has given this subject much attention. The surfaces employed by Prof. Wilmore in his experiments, the beautifully reamed hole and the ground exterior, were such as we would naturally employ for easy slipping rather than for adhesion. In the case of the tension tests, if both surfaces could have been finished with the same fine feed, giving a series of minute ratchet-faced threads that would have interlocked, he could doubtless have shown higher results, although it would have been impossible for him to have measured the diameters so minutely. So if the surfaces for the torsion tests had been finished by lines parallel with the axis, those tests also must have run higher. For simply crushing strains which seem to have been what were to be encountered by the job done by "Glasses," Prof. Wilmore's surfaces would have been the ideal thing.

A shrink fit is one of the simplest jobs of the shop; but still there's something "to" it.

TECUMSEH SWIFT.

A Problem in Rolling Sheet Metal.

Editor American Machinist:

Given a sheet of metal backed up by a flat surface and having a number of rolls passing over it, two being shown. These rolls are supposed to be held down to the surface with sufficient power to lengthen the sheet of metal about 1 inch in rolling a distance of 5 feet. Each roll is tapered slightly for a short distance from each end, as shown, so that while at point *b* one is doing its maximum work, at *c* it is merely touching the metal. The second roll is supposed to slightly overlap the track of the first roll.

Any possible buckling which might occur under this action is disregarded. The two rolls are supposed to be given approximately the same pressure.

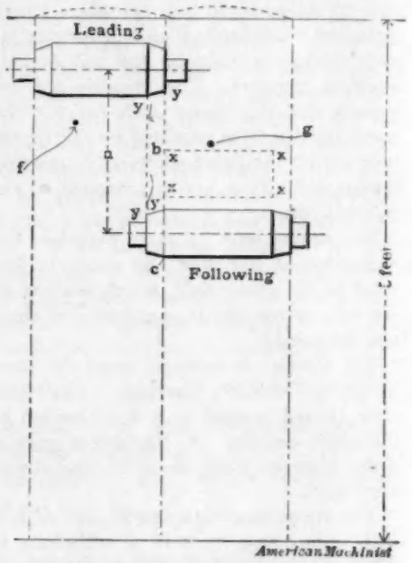
It is evident that after each roll has passed a given point, the particles of metal in its path, behind it, have been moved from their positions and pushed ahead an amount proportional to the distance the roll has gone from its starting point.

Supposing the leading roll to have reached a point, as shown, near the end of its path. Suppose the following roll to be *a* inches behind it.

Question 1—Have the particles of metal in the area *x—x—x—x* been yet affected, distortion being admitted in a small zone of approximately the area *y—y—y—y*?

(2) Would there be any advantage (as relates to the flow of metal) in shortening the distance *a* from 24 inches to 6 inches?

(3) Would there be any disadvantage (as relates to the flow of metal) if the following roll did not start until the leading had reached the end of its path?



A PROBLEM IN ROLLING SHEET METAL.

(4) Is it not a fact that the particles of metal affected ahead of *each* roll a it comes along, are not affected until the roll is within a few inches of each particle, respectively, and therefore that with rolls 12 inches in diameter and overlapping as shown in sketch, any particle of metal in the neutral zone *y—y—y* cannot be affected by the two rolls coincidently?

(5) A claims that the distance a particle *f* is ahead of a formerly parallel particle *g*, after the leading roll has passed, varies with the distance *a*.

B claims that it is not affected by the distance *a*.

Can anyone enlighten us on these points?

HENRY F. NOYES.

Sing Sing, N. Y.

"Overheads" on Lathes for Amateurs

Editor American Machinist:

I notice in a very recent issue of the "American Machinist" a letter regarding "overheads" for lathes and your remarks

thereon. By a proper attachment put on to the lower slide of the compound rest, so as to hold fly-cutters, drills with flat and curved ends, in any lathe with division plate on the spindle, gears can be cut, taps and reamers fluted, slots drilled, etc. As your correspondent truly remarks, "Amateur" lathes are very largely sold in England, and very long prices are obtained for same and their accessories, such as eccentric, epicycloidal and geometric chucks, elliptical cutting tracers, etc., and I think that these articles could be made in the United States and sold in England to good advantage, as the prices there obtained for such are simply extortionate to anyone, like myself, used to American tools. The most expensive lathes are bought by wealthy local amateurs, and very many are sent out to India, Ceylon, etc., for the amateur use of tea and coffee planters, by both of whom ivory and hard woods are easily obtainable. I may remark that a first-class 5-inch center lathe (i. e., 10-inch swing), with the various chuck accessories, is in Holtzappel's catalog from £400 to £800!

. . . . . .

In another matter your correspondent is very right, which is about the marking of twist drills. If the makers would take his suggestion and stamp the size in a recess turned slightly below the surface of the shank of a straight-shank drill, it would be a missionary effort and very civilizing. Also why do not chuck makers make the jaws of their chucks with more steps and closer together? Frequently one step is too small to hold any article, while the chuck will not open sufficiently to allow the next larger step to be used.

. . . . . .

I had omitted to mention, for the information of your friends, that for English or indeed foreign trade, it will be necessary to alter the cone pulleys and driving wheels of lathes, as on the other side these are always, for foot lathes, grooved and run by a ¼-inch or 5-16-inch round gut belt, and never by a flat one, as here.

I noticed a remark in the "American Machinist" some time ago relative to the general use of a sliding bolt for connecting large gear on spindle to cone, when back gear is not in use. In any lathe made by Cunliffe & Groom, of Manchester, England, this method could not be employed, as there is a brass division-plate between gear and headstock, so the connection is made by an eccentric bolt, which is operated by one half turn of a ⅜-inch square stud projecting through the said division-plate close down to the spindle. This is a very neat and good kind of connection, though necessarily more costly than that of a sliding bolt.

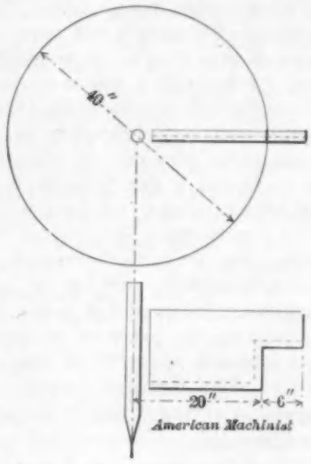
H. E. KEYLE.

Oakville, Ontario.

Molding the Piston.

Editor American Machinist:

Still a cheaper way of making that thin 40-inch piston. Why not sweep it up, and lay the 48-inch pattern one side? A sweep could be made similar to the sketch, having a projection on the outer end, about



SWEEP FOR MOLDING A PISTON.

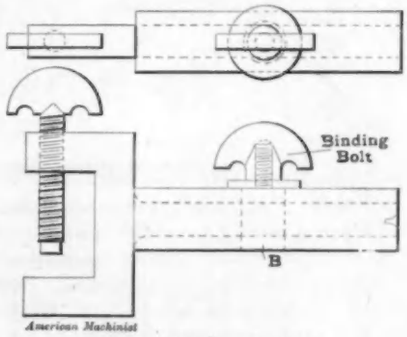
6 inches, making the joint. It could be swept up in the floor; not necessary to use any drag. A cope of any size could be used, providing it would cover the space required. Ram it up on any board that has a good flat surface. On putting the cope on, the mold is completed.

H. BICKLE.

A Die Maker's Vise or Clamp.

Editor American Machinist:

I wonder how many die makers there are who, when they have their die drilled and broached out, proceed to put it in the old Stubbs hand vise, screw this in the bench vise, and then endure the miseries



DIE MAKER'S CLAMP.

of not being able to get the right light on their lines. After trying several ways out of the trouble, I made the clamp as here sketched. The body *B* was made out of 1⅛-inch square steel, 4 inches long, drilled and reamed with ⅝-inch hole. The clamp was made of ⅝-inch stock, with shank welded on and the whole turned a good fit in B. A binding bolt, ⅞ inch diameter, with thumb-nut, was fitted to bind the clamp in any position. After twelve years' experience, I can recommend it as the best I have ever seen. IRONQUILL.

Promoting Inventions—An Engine That Varied the Power With Constant Steam Consumption.

Editor American Machinist:

In a recent issue of the "American Machinist" there were some remarks upon patents, especially with reference to the advising of patentees by experts. There are thousands of men who have good ideas. They patent these and get men of capital to help them. It is very strange to find so many men of capital who are absolutely children on questions of mechanics. They obtain the services of some small mechanical man to make the thing, and the patentee helps this man, and much money is spent. Even if the thing be absolutely good there will still be required an entire remodeling at the hands of an engineer before satisfactory progress can be made. There are several reasons for this want of a proper system of working up an invention. One is that the inventor is very suspicious and thinks everyone is trying to rob him of his treasure. If his watch stops he takes it to the watchmaker and cheerfully leaves it in his hands for repair, content in the belief that he will receive it again and that the watchmaker will not rob him of it. But he will not take his half-baked, unworked-out idea to an expert engineer or draftsman and have it repaired and put into shape, because he fully believes his idea will be stolen. Yet by doing so he would often save much money, and in many cases he would be far better able to dispose of his invention in a legitimate channel could he say that it had been elaborated for him by a practical man.

It is unfortunate that financial aid is often forthcoming to push inventions purely to foist on the public, no matter whether they be good or bad. An invention was unloaded on the public here not very long ago at a price of some hundred thousand dollars. A friend of my own was asked to undertake the manufacture of the article, and he showed me the blueprint. I condemned the thing as unworkable from the blueprint only, and I am sure that in doing so I showed no particular smartness. The faults were only too obvious, and the affair ended in absolute failure. I am confident that if the financial men who backed this invention had been serious in determining to put nothing fraudulent upon the public they would have submitted the invention to some practical man for an opinion of its value. This particular class of financial man, however, does not want a genuine report. He looks for a report which he can print in a prospectus and lay before the public. Properly advertised, the most worthless and absolutely useless so-called inventions can be floated for any amount

of money. It seems to make no difference at all whether a thing will work or will not work. The men on the daily press may not be intentionally dishonest, but when they are invited to come to a test and see a good deal of machinery about, some of which belongs to the invention and some of it does not, they get muddled and jump to the conclusion that as there is so much machinery about there must be something in the invention or no one would spend so much money on testing it. At these so-called private views there is usually plenty of lubrication. No one need be thirsty very long. There appears a descriptive paragraph in one column of a paper, which refers to the advertisement in another column, which last column is usually as wide as the page and as long, and the public rush in, and no one hears anything more of the invention which was to revolutionize everything.

Men who have an invention to exploit are in the habit of asking for an engineer to make tests, and they make a terrible row if the results are unfavorable. In a recent case a syndicate of promoters refused to pay the engineer's fees, and when they were sued they brought all kinds of trivial excuses; but they were set very straight by the Judge's summing up. He said plainly that the syndicate wanted a favorable report, and they didn't get it. Had they got it nothing would have been heard of these reasons for non-payment, but the men of the jury would have been able to read the report in a flaming prospectus at their breakfast tables. The syndicate lost the case; but syndicates are doing this sort of thing every day, and the multitude of bad schemes makes it hard for a really good invention to succeed. It is by no means the case that the engineers who allow themselves to give unduly favorable reports are the poor ones. Engineers in good position, who could afford to do better, will not always stick at giving too favorable reports; so that it by no means is a certain testimonial to the goodness of an invention that it has received the approval of even a man in good standing. It ought to be so, and there are some engineers whose tests can be taken with safety. As regards the practicableness of a patent or of an idea, there is not initially the immediate object of securing the public report, and if inventors could be persuaded to submit their ideas to an engineer's criticism, they might save useless patent fees. As regards many of the crude and unmechanical ideas of men who are in no sense engineers or mechanics, a few moments will sometimes be sufficient to weigh them up. It is, however, very difficult to persuade some of these men out of their ideas. Some years ago a man brought a novel cut-off for patenting to an agent who first referred him to me. The purpose of the invention was to vary the cut-off by a special arrangement. On going into it thoroughly, it appeared that while it certainly did vary the power of an engine, it had no influence whatever on steam consumption. This remained constant. The valve was so arranged that it delayed the steam admission and never varied the cut-off. Thus the cylinder was filled three-fourths full every stroke; but under a heavy load admission took place at the beginning of the stroke, while at less powers the admission was made later, which, however, did not prevent the full volume from getting in every time. On pointing out the fault to the inventor, he was exceedingly annoyed, and he took his invention elsewhere to patent it. He had already sent an engine abroad fitted with the gear—an engine, which, it is to be feared, would not redound much to the credit of English work. W. H. Booth.

London, England.

A Supplementary Milling Spindle.

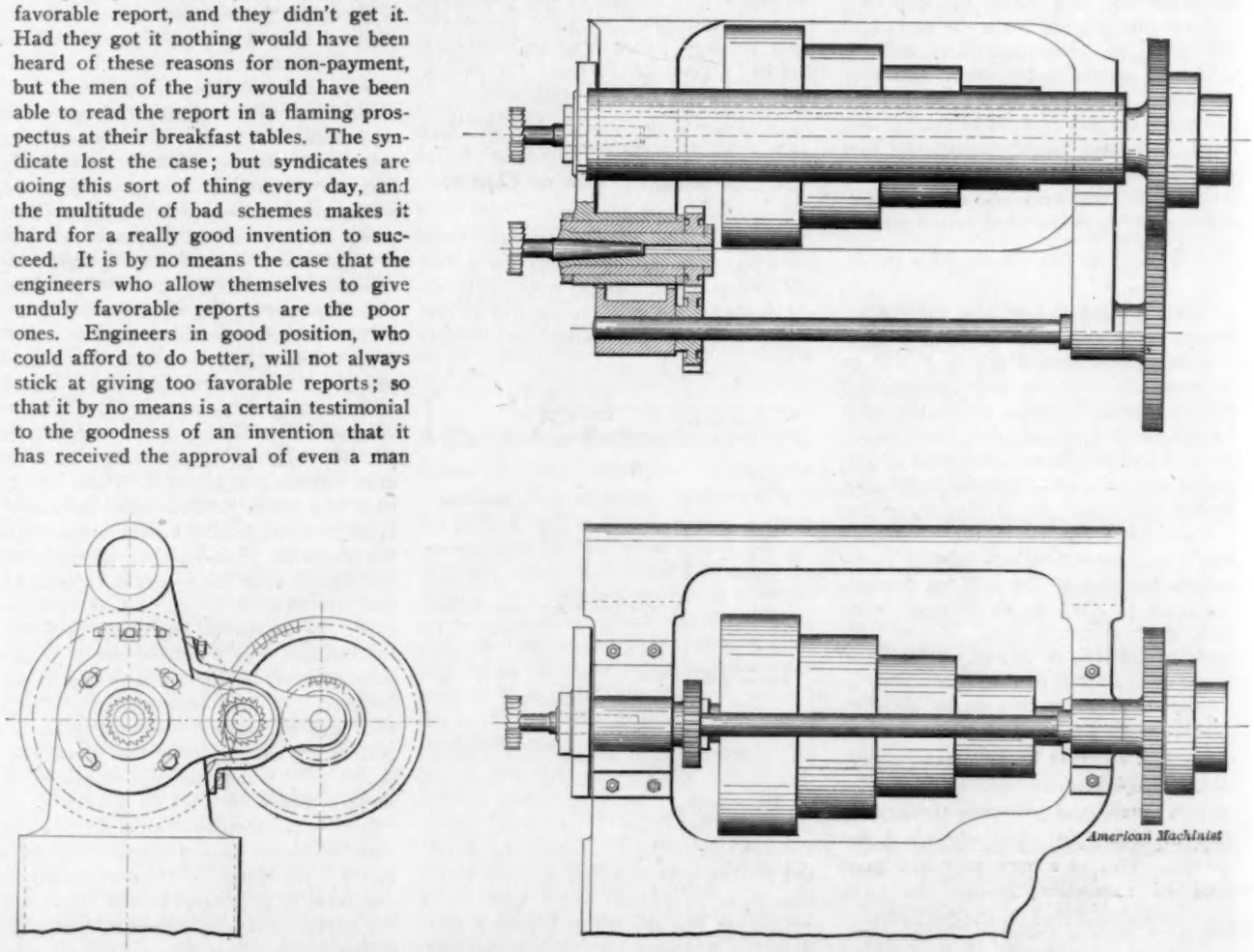
Editor American Machinist:

You may have use for the following description of a double-spindle milling-machine attachment.

In taking a number of cuts over work where a roughing and a finishing cutter are used, the illustrated attachment has been found quite useful, sometimes saving the re-handling of the work and consequent loss of time.

As will be seen, it consists of three castings, two pairs of gears, a shaft and an extra spindle.

The feed pulley on the rear end of the milling-machine spindle is moved so as to permit a gear to be put on alongside of it; this meshes into another, of the same size, on the end of a shaft, arranged par-



A SUPPLEMENTARY MILLING SPINDLE.

allel to the main spindle and carried in bearings fixed to the frame of the machine.

Near the front end of this shaft is another gear, of such size as to mesh with one of corresponding size, on the end of the supplemental spindle. This spindle is arranged to run in a box, made with slight end adjustment, carried by a projection from a plate fixed in front of the machine in such manner that it may be partly revolved on it, thus allowing for adjustment as to hight of cutter, and yet capable of becoming securely fastened to it.

Thus provision is made to bring the two cutters both in line and to have them revolve at the same speed, fairly converting a single into a double-spindle machine.

W. E. Willis.

Philadelphia, Pa.

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer by mail.

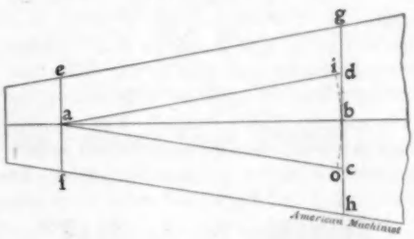
(39) R. H. S., Lansing, Mich., asks: Will you advise me as to the best metal or material to use for high-speed crankshaft bearings? A.—Babbitt metal.

(40) G. E. R., Omaha, Neb., asks: (1) Will any advantage be gained by putting a check valve between an air compressor and the receiver? A.—There is nothing to be gained, while you would have a loss due to the resistance of the valve. The valve would also, no doubt, be noisy. (2) Will a cast-steel plate be injured by punching any more than a rolled plate? A.—As we understand the question, we do not think anything definite is known.

(41) A. W. R., Haffey, Pa., asks: (1) A and J have an argument regarding the word "upsetting," as applied to forging machines forging bolts. A claims it is turning or lapping the end of the iron over to form the bolt head; J claims it is a process of stoving the iron back to form the head. Which is right? A.—So far as we know, all machines use the latter process. (2) What kind of foot valve is mostly used on vertical suction pipes or hose on pumps—a hinged valve or one having a stem cast on the valve disk and working through a guide—and which do you think best? A.—We think the lift valve with guiding stem is the more common, though our own preference is for the hinged construction.

(42) H. B., Somerville, Mass., asks: Do you find any trouble in changing from piece work to the premium plan? In our factory we make vast quantities of a great number of small punchings, etc., and pay for the same at specified rates per thousand pieces. There are probably a thousand different parts, which have perhaps fifty separate operations performed on them. Owing to the smallness of the parts and low cost, it is not advisable to carefully inspect each piece, as inspection would cost more than the goods are worth. Can you cite any examples of the premium plan being adapted to such work, and give the results obtained? A.—The change at the Newton Machine Tool Works was from piece work to the premium plan, but the work done was of a different nature from yours. We have no knowledge of the use of the plan in work of the character of yours. The least advantageous field for the plan is in work of which the output is fixed by the speed of the machines, and this applies to some punch-press work, though not to all. In work of this nature the operator has little control over the output, and the plan would obviously accomplish but little. If your work is of this kind we should not advise you to try the plan; but if, on the other hand, the operator controls the output, we can see no reason why it is not as well adapted to your conditions as to others. So far as inspection is concerned, we suppose that defective pieces are at present rejected in assembling, and it would not, we think, be difficult to so arrange that defective pieces would be charged back to the man responsible for them.

(43) A. L. S., Bristol, Conn., writes: In an article in your issue of January 5 on "Die Construction" the writer says: "With a reamer which has a taper of 1-32 inch in 1 inch this will approximate one degree of clearance in the die." Will you kindly give the amount of taper per foot in a reamer with one degree taper? Does it not approximate 3-16 inch to the foot, or 1-64 to the inch? A.—Let the sketch represent the end of a taper reamer with



the taper purposely very much exaggerated. If *a b* is one foot, then the difference in length between *e f* and *g h* will be the taper to the foot, as commonly measured. Drawing *a d* parallel to *e g* and *a c* parallel to *f h*, and assuming the angle *d a c* to be one degree, angle *b a c* will be one-half of one degree, and *b c* will be the tangent of that angle. From a table of tangents for radius 1, we find that the tangent for one-half of one degree, or *b c*, is .008726, and the length *d c* is, therefore, .008726 × 2 = .017452. Then .017452 × 12 = .209424, which is the taper per foot, stated as a fraction of an inch. As 3-16 inch is, in decimals, .1875, the above is evidently a trifle more than that, and the taper for one inch, or .209424 ÷ 12 = .017452, which is a little more than 1-64, as our querist suggests. This demonstration, however, instead of showing the incorrectness of Mr. Painter's statement that "a reamer which has a taper of 1-32 inch will approximate one degree of clearance in the die," fully confirms that statement, as, of course, the writer referred to a clearance of one degree all around the die, or a clearance of one degree on each side of the reamer, giving it a total taper of two degrees. For two degrees, by the above treatment *d c* would be .03491-inch taper to the inch, or a trifle more than 1-32 inch. Mr. Painter did not say that the taper of the reamer would be one degree, and he clearly implied that it would be two degrees, which is closely correct by the figures.

Personal.

The Standard Pneumatic Tool Company, Chicago, has opened an office at 141 Broadway, New York, which will be in charge of Mr. John D. Hurley.

Carl Christensen, formerly superintendent of the Mossberg & Granville Manufacturing Company, of Providence, R. I., has accepted a position as superintendent of the United States Automobile Company, of Providence.

Frank Mossberg, formerly vice-president and general manager of the Mossberg & Granville Manufacturing Company, of Providence, R. I., has accepted a position as president and general manager of the United States Automobile Company, of Providence.

Mr. C. M. Powers, for several years superintendent of the shops of The Consolidated & McKay Lasting Machine Company, of Beverly, Mass., is now permanently located in Frankfort-on-Maine, Germany, where he has charge of the new shops of that company.

Mr. John Platt, of the firm of Thorpe, Platt & Co., New York, sailed March 25, per steamer "Umbria," on a business trip to Europe, to be gone about two months. It is Mr. Platt's intention to investigate particularly matters connected with the use of the Thorneycroft boiler in large ships.

Wm. M. Barr, of Philadelphia, who was occupied on special engineering work for the navy during the Spanish war, has recently engaged with the C. W. Hunt Company, a portion of his time being spent at the works in Staten Island, and the balance at the New York office, 45 Broadway.

Obituary.

Henry Bollinckx, of Brussels, Belgium, father of our esteemed correspondent, A. Bollinckx, and founder of the large machine works which bear his name, died at his home, Cureghem, Belgium, March 7, seventy-three years old.

Alexander L. Black, a mechanical engineer who was for twenty years in the

employ of the Jackson Architectural Iron Works, of New York, but who retired from business two years ago, died in Brooklyn, N. Y., March 28, in his seventy-fifth year.

John S. McCrum, for many years superintendent of motive power and machinery of the Kansas City, Fort Scott & Memphis Railroad, died March 20, sixty-one years old. He was a native of Pennsylvania, and began his active life as an apprentice machinist in shops of the Pennsylvania Railroad.

Colonel Edwin Jefferies died in Philadelphia March 29, eighty-four years old. He was born in Lancaster, Pa., and was educated as a civil engineer. He entered the railroad shops at Parkesburg, Pa., in 1839, and a few years later was appointed superintendent, remaining until 1854. In 1858 he formed a partnership with J. Barlow Moorhead and began making iron at the Merion furnaces, Conshohocken, Pa., and retired from business fourteen years later.

The Corliss Steam Engine Works and the International Power Co.

In our previous issue we announced the formal transfer of the Rhode Island Locomotive Works to the International Power Company. In connection with the transfer of the Corliss Steam Engine Works to the same company a serious dispute seems to have arisen, which the courts are asked to settle. The following is the statement of the Providence "Evening Bulletin":

"David M. Thompson, in behalf of himself and in the name of the Corliss Steam Engine Company, has begun proceedings in equity and asks the Supreme Court to set aside the entire proceedings of his negotiations and deal with the Hoadley Syndicate on the ground that the whole transaction was a scheme on the part of Joseph H. Hoadley, of New York, to convert and take over to himself and his associates all the great property and plant of the Corliss Steam Engine Company. He denies that the Hoadley Syndicate has any right to the property, and asks that the court grant an injunction against Joseph H. Hoadley, George E. Bouchie, Clarence Neimyer and Lincoln G. Russell to prevent their taking any action under the conveyances and other securities that Mr. Thompson says were obtained from him without proper consideration. He also wants an accounting from the defendants and asks that the property be reconveyed to him on the paying back to Mr. Hoadley the comparatively small amounts that he is said to have paid as a consideration for all that he has received from Mr. Thompson."

In the meantime Mr. Hoadley says that he is in physical possession of the works and intends to remain so, and asserts that no compromise can be effected; but as the courts have been asked to settle the matter, they must be allowed to do so.

Technical Publications.

The company, H. Bollinckx, Brussels, send us a French-English technical dictionary of tools and utensils employed in certain manual trades, industries, etc. It was compiled primarily for their own use by A. S. Lovendal. The greater part of the words contained in the book are said to be found in no other French-English technical dictionary. Hence it will fill a unique place as a supplement to other lexicons. The lines of apparatus and tools comprised in the terminology are as follows: Lifting apparatus, household implements, compasses, vises, axes, files, handles, hammers, drilling tools, shovels and spades, pliers, bills, saws, accessories for saws, agricultural tools, surveyors' tools, woodworkers' tools, chisels, ripping chisels, gouges, drawing knives, spokeshaves, plane irons, grooving irons, molding irons, butchers' tools, and wheelwrights' and carpenters', shipbuilders', shoemakers', roofers' and slaters', engravers', turners', carvers', farriers', joiners', miners', metal workers', plasterers', masons', stone cutters', paper mill, plumbers', tanners', coopers', cloggers', and sugar mill tools. The dictionary is published at Paris by Boyveau & Chevillet, 22 Rue de la Banque; price 3 francs.

"Advanced Metal Work. In Three Parts. Part I—The Speed Lathe." By A. G. Compton and J. H. De Groodt. 134 5x7¼-inch pages, with 99 illustrations. John Wiley & Sons. Price $1.50.

Our first criticism on this book is that it is not advanced and that but a small part of it relates to metal work. How advanced it is may be gathered from its size and from the fact that it begins with the rudiments of wood turning. It is the first one of a series, and it may be that the later volumes will better justify the title, but for this volume a better title would be "Elementary Wood Work." The engravings are poor, and in some cases, where perspective effects are aimed at, vile. By these criticisms we do not wish to be un-

(*Continued on page 39.*)

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting, Grant; see p. 16.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Forming lathes. Mer.Mach.T.Co.,Meriden,Ct.

Agents in every shop to sell my tools; liberal discounts. E. G. Smith, Columbia, Pa.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking," price $1, post paid. J.L.Lucas,Prov.,R.I. Send for index sheet.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., New York.

For Sale—One Sellers 84-inch boring and turning mill. Address The Standard Machinery Co., Mystic, Conn.

Threads and gears; easy rules to cut any thread possible to be cut in the lathe, without algebra, sent to any address for 25c. by G. W. Dixon, Spring Lake, Mich.

Bound volumes of "American Machinist" for 1893 and 1894, cloth, good condition, $3 each; one of 1888, morocco, $4. "Volumes," care AMERICAN MACHINIST.

Best workmanship; reasonable charges; watch, clock and other light machinery; send for samples of punch and die work. Waltham Machine Works, Waltham, Mass.

Expert seeks tabular work; tables carefully calculated to any formula; catalogs written up; metric calculations undertaken. Wm. Cox, 15 Jaques st., Elizabeth, N. J.

Institutions retiring from business having machine tools, brass or wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

Wants.

Situations and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisement under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.

Situations Wanted.

Wanted—Responsible position; 15 years' experience in charge of a shop building knitting machines. Box 209, AMER. MACHINIST.

Wanted—Position as foreman machine shop; an American, 34 years of age; extensive experience in handling men; practical cost-cutter. Address Box 217, AMER. MACH.

Position to design and construct automatic machinery, also special tools and fixtures to reduce cost of manufacturing; 15 years' experience. Address Box 219, AMER. MACH.

Wanted—A young man with 14 years' practical business experience in office, shipping and stock rooms of a machine shop, desires to make a change. Address Box 221, AM. MACH.

Situation wanted by an experienced machinist, at present foreman of a shop employing 100 men; machine tools, engines and jobbing. Address Box 215, AMERICAN MACHINIST.

Tool-maker and designer on cutting, drawing and compound dies, automatic machinery and general tool work, desires change to East or South; capable of taking charge as foreman or supt. Address Box 222, AMER. MACH.

Position wanted as factory supt., master mechanic or similar position of trust and responsibility; held similar position for past 6½ years; first-class mechanic and fair draftsman; a hustler; thoroughly familiar with the handling of help on piece work. Apply Box 205, AMERICAN MACHINIST.

A practical, inventive, up-to-date mechanical superintendent, with 16 years' experience in typewriter, sewing-machine, bicycle and all kinds of light manufacturing, desires a change; thorough, systematic; Eastern man, age 32, American; first-class references; small town in N. Y., Pa. or O. preferred. Address Box 216, AMERICAN MACHINIST.

Help Wanted.

Wanted—All-round gear-cutting man for Boston shop; also man for office; give full particulars. Address "Gear," AMER. MACH.

A draftsman for tools and jigs; state experience, salary wanted, and give reference. Box 220, AMERICAN MACHINIST.

Wanted—At once, 40 machinists for different kinds of work in shop. Address, stating experience, Box 206, AMER. MACHINIST.

Wanted—Tool-maker used to fine work, competent to work from drawings; work similar to watch lathes and high-grade machine tools; shop located in Greater New York. Address, stating age, experience and wages wanted, Box 218, AMERICAN MACHINIST.

Wanted—By large machine works in Germany, a thoroughly competent designer of large lathes, planers and large boring mills; applicants must be well acquainted with best American practice, and must also be posted on the operation of these machines; knowledge of German not essential; give full particulars as to experience, age and salary expected. Box 147, AMERICAN MACHINIST.

Wanted—A foundry foreman for a small shop in Southwest Texas making architec-

tural Ironwork, machinery castings and brass work; must understand mixing metals and be able sometimes to get good work without making it twice; give reference and salary wanted for a permanent job. "Foundry," Box 196, AMERICAN MACHINIST.

Machinery Salesman—By a large export firm, a man to sell American machinery in Europe; must be a thorough mechanic, conversant with a general line of machine tools, and with ability to solicit orders understandingly; must have a thorough knowledge of German. Address "Export Salesman," AMERICAN MACHINIST.

NEW ENGINE LATHE.

All American rights in a new engine lathe are offered for sale. This machine has been pronounced by mechanical experts to be in advance of anything now built. The advertiser is unable on account of other business to put this machine on the market. A first machine has been built and is now in successful operation. The machine employs a thread-cutting device superior to the Norton and entirely independent of it. Address A. T. W., care "American Machinist."

CLEVELAND GEAR WORKS,
W. R. SAWYER, Lessee.
86 SENECA STREET,
CLEVELAND.

GEARS of all descriptions

YOU CAN'T LOSE

an education, but you can obtain one which will qualify you for a better position and higher pay if you will devote some of your spare time to study at home at a cost so low that you will not feel the outlay. Courses by mail in

Mechanical, Steam and Electrical Engineering,
Mechanical Drawing and Machine Design.
Best Text Books and Drawing Plates Free.

Seven years of experience in teaching by correspondence. Write for our illustrated circular T, sample pages of text books, drawing plate, and booklet of letters from students all over the world.

The United Correspondence Schools,
154, 156, 158 Fifth Ave., New York

For Special Machinery and Tools
ADDRESS
Mansfield Machine Works, Mansfield, Ohio.

J. M. ALLEN, President.
WM. B. FRANKLIN, Vice-President.
F. B. ALLEN, Second Vice-President.
J. B. PIERCE, Secretary.
L. B. BRAINERD, Treasurer.
L. F. MIDDLEBROOK, Assistant Secretary.

The CROSS OIL FILTER

actually reduces oil bills 50% or more. Sent on approval. Capacities 3 to 120 gals. per day. Used in 21 countries. Testimonials from the leading firms in every field of industry.

THE BURT MFG. CO.
AKRON, OHIO, U. S. A.
Business Established 9 Years.
Largest Manufacturers of Oil Filters in the World.

Only one cutter is required for each pitch,

and that "cutter is correct." Instead of having a cupboard full you can keep them all on one nail, and pay for them with corresponding ease.

If you cut gears, don't fail to ask

The Fellows Gear Shaper Co.
of Springfield, Vt., about it.

REPAIR BICYCLES FOR A LIVING!

EASY WAY TO MAKE A GOOD LIVING.

Bellows, Blowpipe, Vise, Files, Spokes, Pliers, Spoke Threader, Caliper, Cones, Repair Parts. Complete Outfits. Send 25 cents in U. S. stamps, for illustrated treatise, "HOW TO REPAIR BICYCLES," by competent authorities, and a fully Illustrated Catalog embracing thousands of bargains in Tools, Fittings and Repair Parts.

The Frasse Company, 17 Warren St., New York (after May 1st, 38 Cortlandt Street, New York).

Electrical Equipments For Machine Shops.

The Eddy Electric Mfg. Co. has made a special study of the best methods of equipping Machine Shops with electric power, and has exceptional knowledge and facilities for doing such work in the right way. Correspondence invited.

The Eddy Electric Mfg. Co.,
WINDSOR, CONN.
New York, 143 Liberty St. Chicago, Marquette Bldg.
Cable address: Dynamo, Windsor.

SHAPERS

12 TO 32 IN. STROKE

MANUFACTURED EXCLUSIVELY.

SMITH & MILLS,
CINCINNATI, OHIO,
U. S. A.

(*Continued from page 38*).

derstood as condemning the book. On the contrary, it is a practical instruction book in hand-turning in wood, and to a lesser extent in brass, which should be decidedly useful to the young amateur, and it should also save a large amount of wearisome repetition of elementary instruction in trade schools, for which, we understand, it is chiefly intended.

The interests of the Providence (R. I.) "Journal of Commerce" and the Board of Trade journal, published in the same city, have been consolidated, and the title by which the publication will in future be known will be the "Providence Board of Trade Journal."

The United Correspondence Schools, New York, have issued a pamphlet entitled "What Students Say," and which contains extracts of letters from students in various parts of the country testifying to the merits of the method of instruction as carried on by the schools referred to.

Lieutenant Wells, in command of the naval recruiting station in Chicago, has received instruction to enlist an unlimited number of first-class machinists for service in the navy. The men are required to reinforce Admiral Dewey's forces in Manilla, and to fill vacancies in the North Atlantic squadron.

Glasgow, Scotland, is to hold an International Exhibition in 1901. Indications now are that the exhibition will prove to be an entire success, and will be divided into sections, among which the following will receive particular attention: Locomotion and transport, electricity, labor-saving machinery and marine engineering.

We are informed that Mr. John J. Grant, of Cleveland, Ohio, while living in Greenfield, Mass., built in 1868 and operated a road carriage driven by steam, which he declares was entirely satisfactory and would have continued running had it not been that the Selectmen stopped its use upon the public highways because it frightened horses.

The University of Illinois announces that a course in Railway Engineering will be added, and that work in this department may be begun at the opening of the next university year—i. e., September, 1899. Considerable work has already been done by the Department of Mechanical Engineering in this direction, and the supervision of the work will still remain with Prof. L. P. Breckenridge, of the Mechanical Engineering Department.

It is announced that the United States exported a larger amount of merchandise in the calendar year 1898 than the United Kingdom of Great Britain and Ireland. Our figures were $1,233,564,828, and Great

Britain's $1,131,914,331. This, of course, has never occurred before, and marks the beginning of a new state of commercial affairs. In the above statement are not included the ships built in Great Britain for foreign account, so that we have still quite a difference to make up.

Manufacturers.

The Warren Light Company, Warren, Ohio, is preparing to build a new plant to cost $40,000.

The Port Murray Terra Cotta Company, at Port Murray, N. J., has decided to build an addition to the works.

The name of Goodell Brothers Company, of Greenfield, Mass., has been changed to the Goodell-Pratt Company.

The Hollingsworth & Whitney Paper Company, of Boston, Mass., has decided to enlarge its Winslow plant.

The Florence Manufacturing Company, Florence, Mass., is contemplating improvements the coming season.

The Jefferson Ice Manufacturing Company is to have a brick factory erected at Janney Station, Montgomery County, Pa.

The Standard Pneumatic Tool Company, of Chicago, contemplates the enlargement of its plant and the installation of more machinery.

The York Match Company, York, Pa., owing to increase of business, is to erect an addition to its plant 60x80 feet and five stories high.

The Cleveland (Ohio) Car Company is the name of a recently organized company to engage in the building of industrial railroads, rolling stock and accessories.

The contract for the Wheel & Cycle Bar Company's new factory, to be erected in Berlin, Conn., has been awarded to the H. Wales Lines Company, of Meriden. The building is to be of brick, three stories in hight and 45x148 feet.

Bids have been received for the contracts on the six-story factory building to be erected for Romadka Bros., Milwaukee, Wis., on Fourth street, adjoining their present plant. It will cost $25,000 and will be of brick construction.

Sealed proposals will be received until 12 o'clock noon, April 27, 1899, for the lighting of the streets of Mechanicsburg, Pa., by electricity. Particulars may be obtained from C. N. Owen, Chairman Light Committee, Mechanicsburg, Cumberland County, Pa.

The Manufacturing Investment Company, owning a water power and pulp mill at Madison, Me., has decided to increase their plant in every branch and add a paper mill at an estimated expenditure of $500,000, work upon which will be commenced the last of April.

The partnership of Thos. G. Oakes & Co., 54 John street, this city, has been dissolved, Mr. Oakes having made arrangements to continue the sale of valves, packing, etc., through Messrs. Dame & Townsend Company, 76 John street, with whom he has associated himself.

Some time ago Denis & Danziger, New Orleans, La., sold a large tract of land on the river front, between Berlin and Milan streets, on which Haubtman & Loeb intend to erect a valuable manufacturing plant in their line. The building, it is reported, will be of steel and cost more than $20,000.

Contracts have been made and work begun by the Lancaster (N. Y.) Machine & Knife Works, on a new plant to replace the one recently destroyed by fire. The plans call for three separate buildings, which will be built

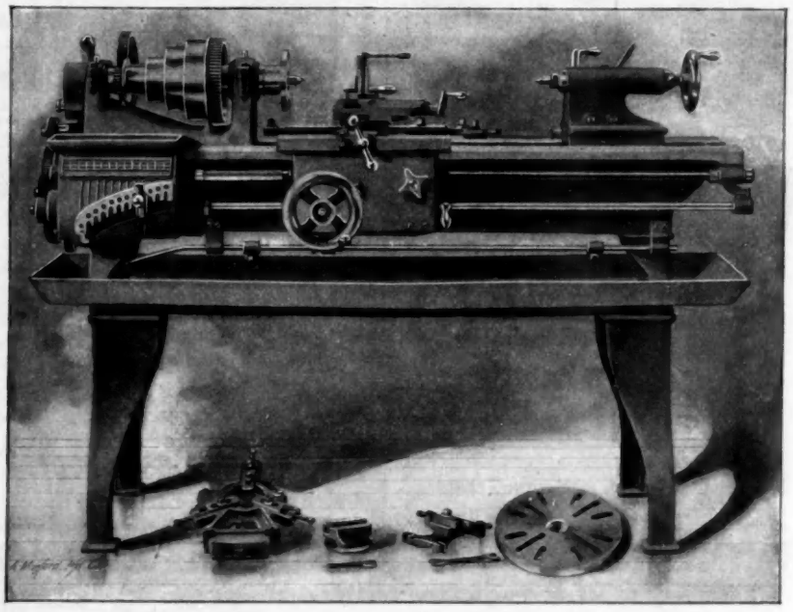
(*Continued on page* 41.)

The Hendey Machine Co.

TORRINGTON, CONN.

This Company is the sole owner of Letters Patents Nos. 470,591, 519,294 and 549,006, granted to W. P. Norton for Improvements in Engine Lathes.

We take this method of notifying the public that we have already commenced suit against infringers of these patents, and that should it be found necessary to the protection of our rights, additional suits will be brought against manufacturers, vendors and users of infringing lathes.



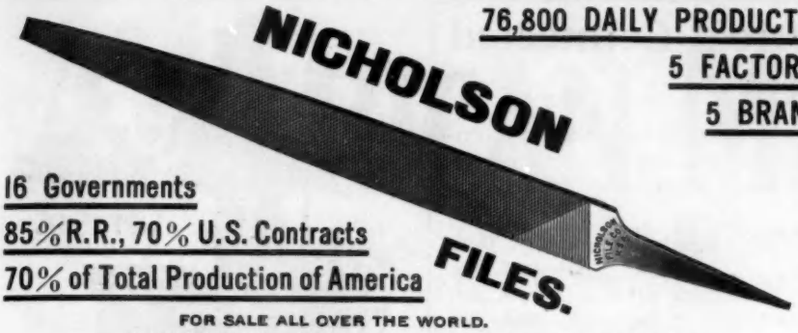
The merits of these improvements have been widely recognized and have been wantonly copied. We shall take vigorous steps to protect our own.

The Hendey Machine Co.,

TORRINGTON, CONN.

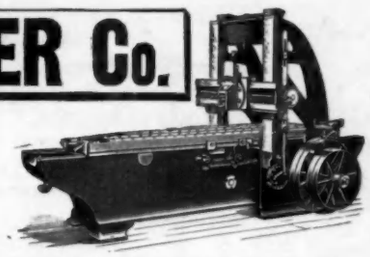
AGENTS FOR THE PACIFIC COAST:
Pacific Tool and Supply Co., San Francisco, Cal. J. W. Cregar, Philadelphia Bourse Exhibition.

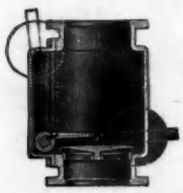
EUROPEAN AGENTS:
Schuchardt & Schutte, Berlin, Vienna, Brussels. Chas. Churchill & Co., London and Birmingham, England
Adolph Janssens, Paris, France.



76,800 DAILY PRODUCTION
5 FACTORIES
5 BRANDS
16 Governments
85% R.R., 70% U.S. Contracts
70% of Total Production of America
FILES.
FOR SALE ALL OVER THE WORLD.
NICHOLSON FILE CO., Providence, R. I., U. S. A.

POWELL PLANER Co.
WORCESTER, MASS.
U. Baird Machinery Co., 125 Water St., Pittsburgh, Pa.
Robinson & Cary Co., St. Paul, Minn.
W. R. Colcord Mchy Co., 502 North 2d St., St. Louis, Mo.
Parke & Lacy Co., Fremont St., San Francisco, Cal.
The Fairbanks Co., 705 Arch St., Philadelphia, Pa.





Excelsior Straight-Way Back Pressure Valve.

This valve has no dash pots, springs, guides or complicated levers to get out of order. It is simple, reliable and well made. Never sticks, and can be relied upon at all times when using exhaust steam for heating; or when used as a relief, or free exhaust on a condensing plant, it has no equal. It is noiseless and free from any complicated attachments.

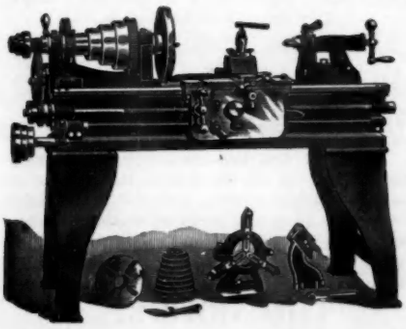
Jenkins Brothers, New York, Boston, Philadelphia, Chicago.

MACHINE DESIGN. BY FORREST R. JONES.
PART II. FORM, STRENGTH, AND PROPORTIONS OF PARTS.
ix + 353 pages. 179 figures. 8vo. Cloth. $3.00.
Order through your bookseller; or copies will be forwarded, postpaid, by the publishers on receipt of the retail price
JOHN WILEY & SONS, 53 E. 10th St., New York City.

LONG-LIVED GRINDING WHEELS
are money saving wheels. A Carborundum wheel will grind much more than an emery wheel before becoming useless.

CARBORUNDUM

wheels last longer than emery wheels because the extreme hardness of the material enables us to use hydraulic pressure in forming them, which makes them much more solid and stronger than a porous, loosely-constructed emery wheel in which the grains are much softer.
THE CARBORUNDUM CO., NIAGARA FALLS, N.Y.



"Sebastian" Lathes
(13 and 15 inch swing).
Beds Any Length Desired.

High grade, modern lathes at a low price. Each lathe is provided with both screw and rod feeds, as well as power cross feed. Gears to cut all standard threads from 5 to 36 are furnished.

Workmanship, material and design are of the highest order.

You can't find anything better.

We also make a specialty of Screw Cutting Foot Lathes.

Sebastian Lathe Company, 117 & 119 Culvert St. Cincinnati, Ohio.

AGENTS.—Selig, Sonnenthal & Co., London, England. Jn. Tragardh & Co., Goteborg, Sweden. E. Sonnenthal, Jr., Berlin, Germany. R. S. Stokvis & Zonen, Rotterdam, Holland.

(*Continued from page* 40.)

of brick and be thoroughly modern in every respect. The new factory will be larger than the old.

Plans have been submitted to the bureau of Building Inspection providing for the erection of a four-story brick mill for the Miller Lock Company, on Tacony street, in Frankford, Pa. The proposed structure will measure 43½x110 feet, and it is estimated that the work will cost in the neighborhood of $10,000.

The United States Automobile Company, of Pawtucket, R. I., has recently been incorporated with a capital of $250,000, for the purpose of manufacturing electric motor carriages and appliances. President, Frank Mossberg, of Providence, R. I.; Treasurer, Julian A. Chase, Pawtucket, and Secretary, D. McNiven, of Providence, R. I.

The increasing demand of the Toledo Machine & Tool Company has necessitated enlarged quarters, and the company have secured the plant of The Yost Manufacturing Company. In their new location they have a blacksmith shop 50 by 90 feet, a machine shop 76 by 163 feet, die room 76 by 150 feet, and large erecting, storage and shipping rooms. A 1,500-pound steam-power hammer, two traveling cranes and an extensive electric plant are among the features of the new location.

The Shaw Electric Crane Company, Muskegon, Mich., will at once extend its main building 160 feet to the north. In other words, the company will build an addition to its factory large enough to nearly double the size of its present works, exclusive of the bridge shop. The main building is 100 feet wide and 200 feet long. When the extension is finished the building will be 100 by 360 feet in size. The extension will become a part of the machine shop and will be occupied with machinery after about the same plan as the present shop is.

New Catalogs.

The Ball Bearing Company, of Boston, Mass., has issued its 1899 catalog. This catalog has a new feature in the form of flexible cloth covers, and is devoted exclusively to the illustration and description of roller journal bearings and ball thrust bearings. The catalog is 4½x7 inches.

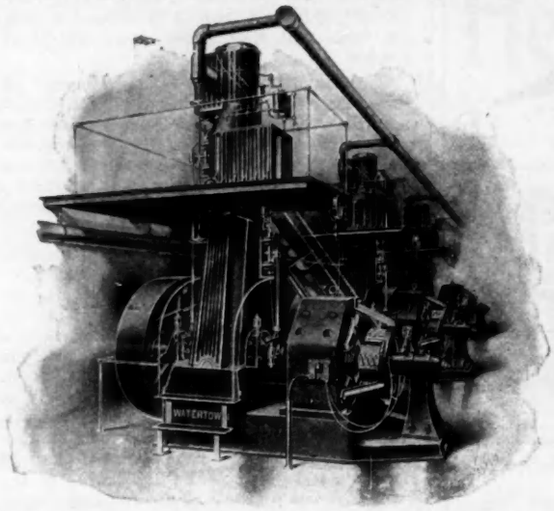
We have received a copy of the February Bulletin of the University of Minnesota, containing an outline of the work of the department of mechanical engineering. An examination shows progress in the right direction. Thus we observe the addition of shop administration and cost-keeping, and of jig and tool design, to the standard list of subjects taught.

A report by Professor Forrest R. Jones to the president of the University of Wisconsin on the condition of the College of Mechanics and Engineering, has been sent to us. The growth of this department compared with other departments of the university and with similar departments of other universities, is shown by a series of diagrams, from which we gather that the percentage of increase of this department leads in all the comparisons which are made.

We are in receipt of the Cornell University Register for 1898-99. With the growth of the university this catalog has grown to be a volume of over 400 pages. The most marked advancement of the present year lies, of course, in the new College of Medicine and the State College of Forestry. The total attendance at the university now numbers 2,038, of which 492 are in the department of mechanical engineering. The faculty numbers 281 resident teachers of all grades, with forty-seven non-resident lecturers.

Where Watertown Direct-Connected High-Speed Engines Go

is a thing we are glad to tell, because they go into big and successful concerns everywhere—concerns who will have only the best, and whose machinery is chosen by experts. We give here a partial list of recent installations :



INSTALLATION FOR POPE MFG. CO., HARTFORD, CONN.

M. A. HANNA & CO., Cleveland, Ohio.
CONN. MUTUAL LIFE INS. CO., Hartford, Conn.
LEHIGH VALLEY R. R. CO., Buffalo, N. Y.
WESTERN COAL & MINING CO., Altus, Ark.
AMERICAN BREWING CO., St. Louis, Mo.
ST. LOUIS EXPOSITION, St. Louis, Mo.
NEW ORLEANS "CITY ITEM," New Orleans, La.
METROPOLITAN ST. R. R. CO., Kansas City, Mo.
ROOSEVELT HOSPITAL, New York City.

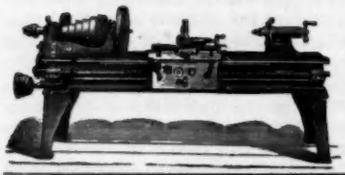
We would like to send you our Engine Book. It tells in an interesting way why Watertown Engines are good Engines, and gives full particulars concerning them. We make Steam Engines and Boilers for all purposes and would be glad to correspond with you on the subject.

Watertown Engine Company, Watertown, N.Y., U.S.A.

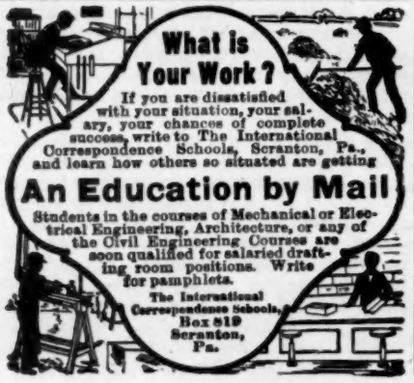
Pulleys, Ring Oiling Hangers.
Pulley Moulding Machines, Pulley Lathes.
T. B. WOOD'S SONS,
Chambersburg, Pa.

Bevel Gears
Cut Theoretically Correct, Special facilities for cutting worm and spiral wheels.
Hugo Bilgram, Machinist,
440 N. 12th St., Philadelphia, Pa.

The Hamilton Machine Tool Co.,
Hamilton, Ohio, U. S. A.
ENGINE LATHES, 14, 16 and 18 in. Swing.
UPRIGHT DRILLS, 12, 16, 20, 21, 24, 28, 32, 36, 40 and 44 inches.



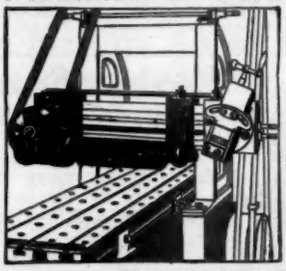
Our tools are all completely modern machines with many special features, which are fully described in our illustrated catalog. Write for one before you purchase.


What is Your Work?
If you are dissatisfied with your situation, your salary, your chances of complete success, write to The International Correspondence Schools, Scranton, Pa., and learn how others so situated are getting
An Education by Mail
Students in the courses of Mechanical or Electrical Engineering, Architecture, or any of the Civil Engineering Courses are soon qualified for salaried drafting room positions. Write for pamphlets.
The International Correspondence Schools,
Box 819
Scranton, Pa.

"The Reeves" Wood Split Pulley,
with interchangeable bushing system for belt power transmission.
Lighter than an iron pulley. Stronger than a steel pulley. Each pulley will fit thirty-five sizes of shaft. No set screws. No keyway. Complete stocks carried in every jobbing center in the United States. Also
Chas. Churchill & Co., 9 to 15 Leonard St., London, Eng
Fenwick Freres & Co., 21 Rue Martel, Paris, France.
White, Child & Beney, Vienna, Austria.
Reeves Pulley Co., Columbus, Ind., U. S. A.,
Send for Catalog. Manufacturers.

We'll tell you all about it.
THE DETRICK & HARVEY MACHINE CO.,
BALTIMORE, MD., U. S. A.

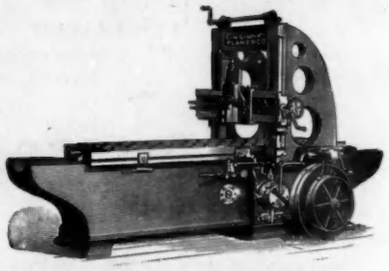
MILLING MACHINE



combined with any
Iron Planer
swivels from Horizontal to Vertical.
Do not plane surfaces that should be milled or mill surfaces that should be planed.

SEND FOR CATALOG.
The Adams Company, Dubuque, Ia.

PLANERS
24 to 36 inches square.



Patent Combination Friction.
New Feeding Device.
Crucible Steel Shafts.
Powerful Gearing, etc.
The Cincinnati Planer Co.
CINCINNATI, OHIO, U.S.A.
Cable Address: Planer-Cincinnati.

Machinery is Shown in Motion,

the products of different makers side by side, at the Exhibition Department of the Philadelphia Bourse, where 18,000 square feet of floor space are given up to this one line. There's no better place in the whole world to buy or sell good machinery. Get the Bourse Book, free. Address

THE BOURSE,
THOS. S. WELSH,
Supt. Exhibition Department,
PHILADELPHIA.
"In the Business Center."